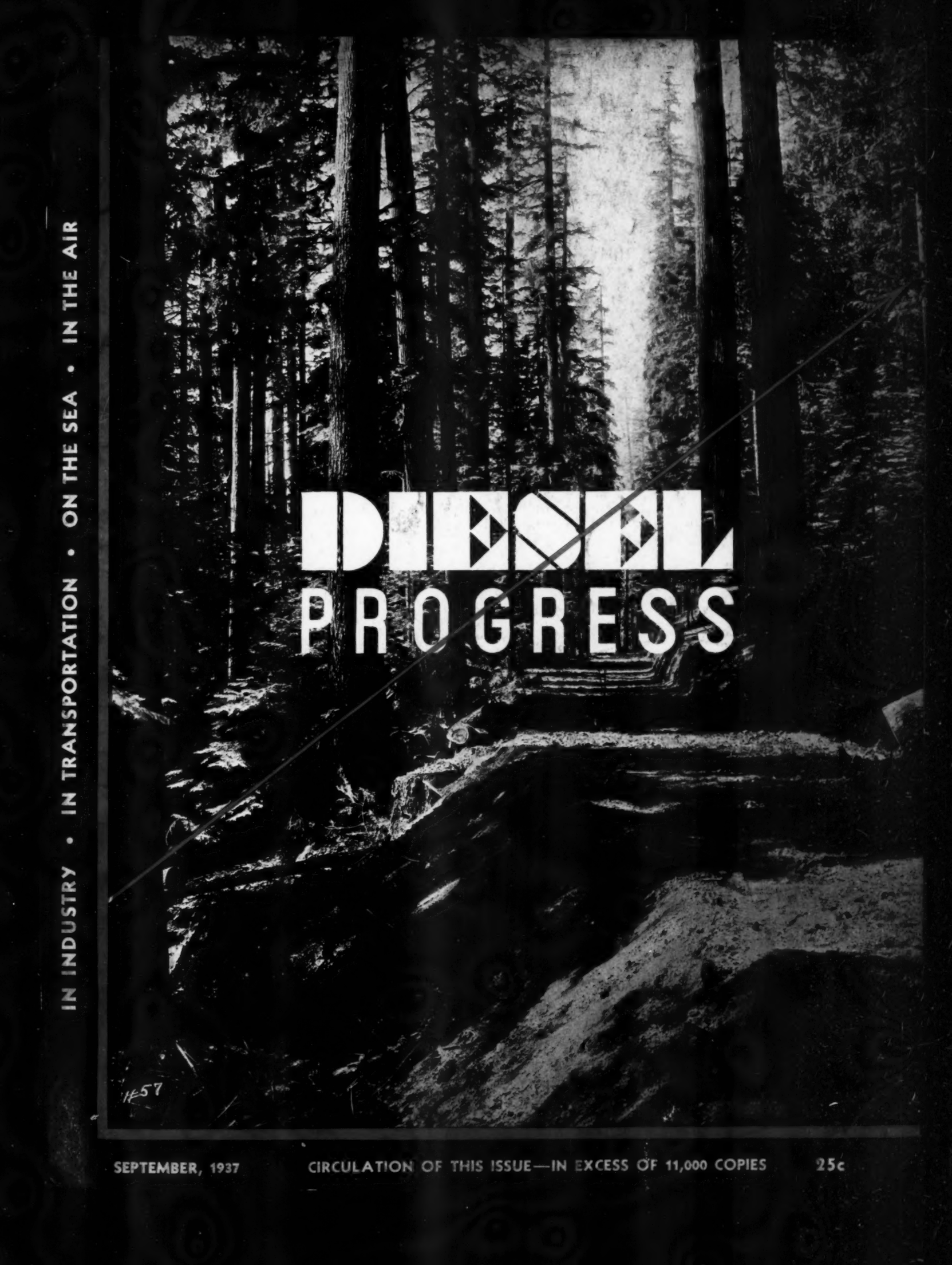


SEPTEMBER, 1937 CIRCULATION OF THIS ISSUE—IN EXCESS OF 11,000 COPIES 25c

PARTNERS

HERE is a familiar scene in Diesel power plants today —the Gulf lubrication engineer working in cooperation with the plant engineer.

Both have a definite objective: To get the most efficient lubrication possible for every moving part of the engine. So they "team up," pool their knowledge and experience in a united effort to defeat friction.

The Gulf engineer is well fitted to carry on this cooperative work. His entire time is spent in gaining and applying knowledge of oils and greases—to the end that engines and machines may operate more efficiently and economically. He works with plant men, recommending the use of lubricants exactly suited to each moving part and suggesting the best methods of application.

Such careful attention to lubrication pays a generous reward in lowered costs for maintenance. The Gulf line includes more than 400 quality oils and greases. The combination of this quality line of lubricants and Gulf's engineering counsel can help *you* attain maximum efficiency for every Diesel engine *you* operate.

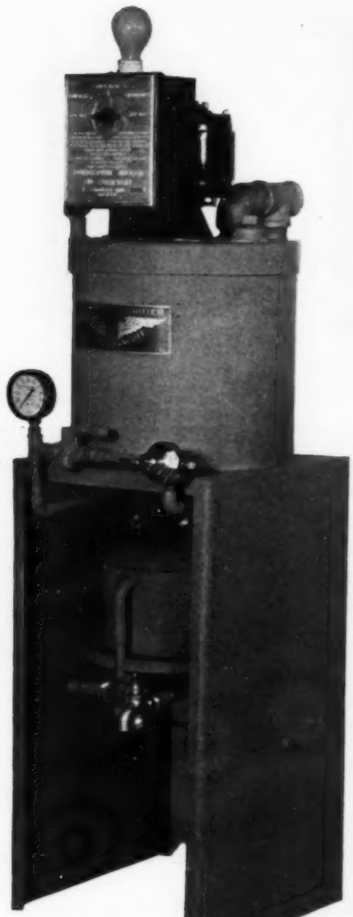
Gulf Oil Corporation GULF INDUSTRIAL LUBRICATION **Gulf Refining Company**

GENERAL OFFICES: GULF BUILDING, PITTSBURGH, PA.

DIESEL PROGRESS for September, 1937. Volume III. No. 9. DIESEL PROGRESS is published monthly by Diesel Engines, Inc., 2 West Forty-fifth Street, New York, N. Y. Rex W. Wadman, President. Acceptance under the Act of June 5, 1934, at Brooklyn, New York, authorized May 14, 1935. Subscription rates: United States and Possessions $3.00, Canada and all other countries $5.00 per year. Single copy price 25 cents in U. S. A., 50 cents for all other countries.

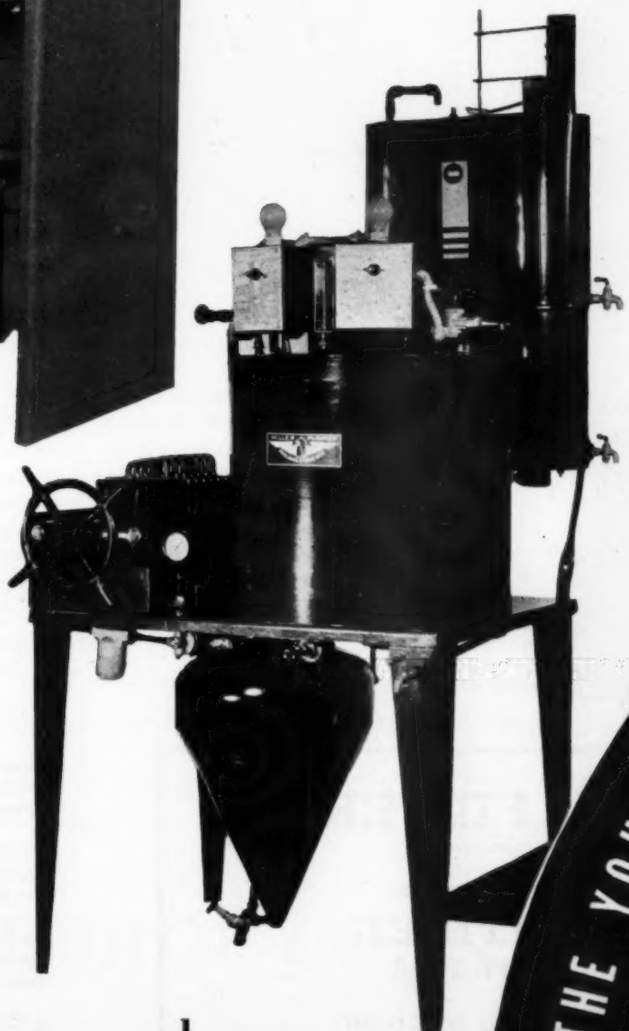
Lubricating Oil *Can* be Kept Clear and Sparkling

FUEL DILUTION—ACIDS—WATER—SLUDGES—GUMS COLLOIDAL CARBON—FREE CARBON—ABRASIVES—ALL ARE REMOVED BY THIS EQUIPMENT—UNDER AUTOMATIC CONTROL AND WITHOUT PRE-TREATMENT OR SETTLING—WITH MOST OILS THE COLOR CAN BE RESTORED



MODEL G-15

This low priced unit makes the Youngstown Miller process available to the smallest plant and fleet. It performs identically with the large purifiers.



MODEL A-15

This illustration typifies the general appearance of all the larger Youngstown Miller units.

Used by Five Diesel Manufacturers in reconditioning oils for reuse in regular testing of new engines.

The Bloomington, Ill., Grand Haven, Mich., Holton, Kan., Rensselaer, Ind., Rochelle, Ill., Lake Mills, Wis., Municipal Plants; Illinois Central Railroad, Erie Railroad and many other equally outstanding engine users are successfully using these units—in most cases displacing more expensive equipment.

Transformer, automobile and truck engine, steam turbine, and ice machine oils can also be restored.

If you will use this coupon today—now—and tell us about your plant—we will promptly advise the size unit to meet your requirements.

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Make of Engines.....
.....
H.P. of Each Engine.....
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Quantity of other oils.....
Kind .....
Name .....
Address .....
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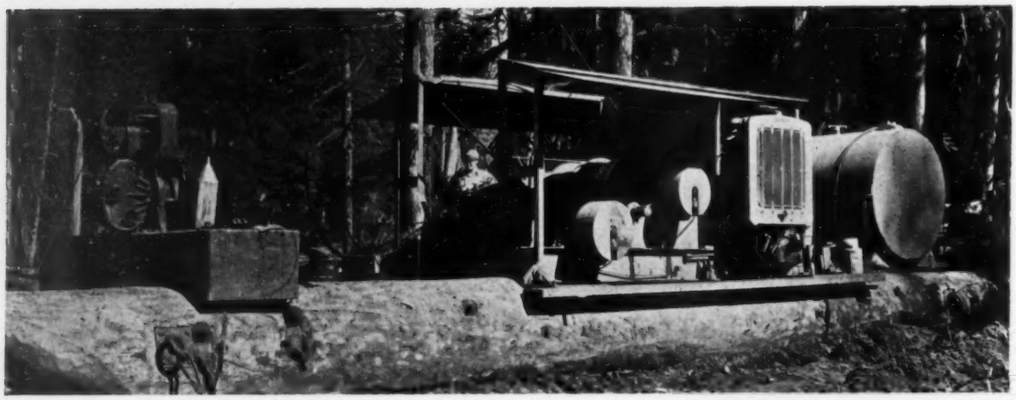
· DIESEL FILTERS ·

"Sentinel" Oil Filters for Diesel Logging Equipment



Sentinel Filter Model 7

Is your Diesel Engine on that inevitable march to the junk heap at double time?

This march can not be stopped but its speed can be reduced to a minimum by the use of "Sentinel" Oil Filters.

"Sentinel" Oil Filters eliminate all chances of dirty fuel and you can rest assured that your engine is receiving as clean fuel as money can buy when guarded by a "Sentinel,"

Here are a few users of "Sentinel" Oil Filters on Diesel Logging tractors, shovels or road equipment who are convinced of this fact.

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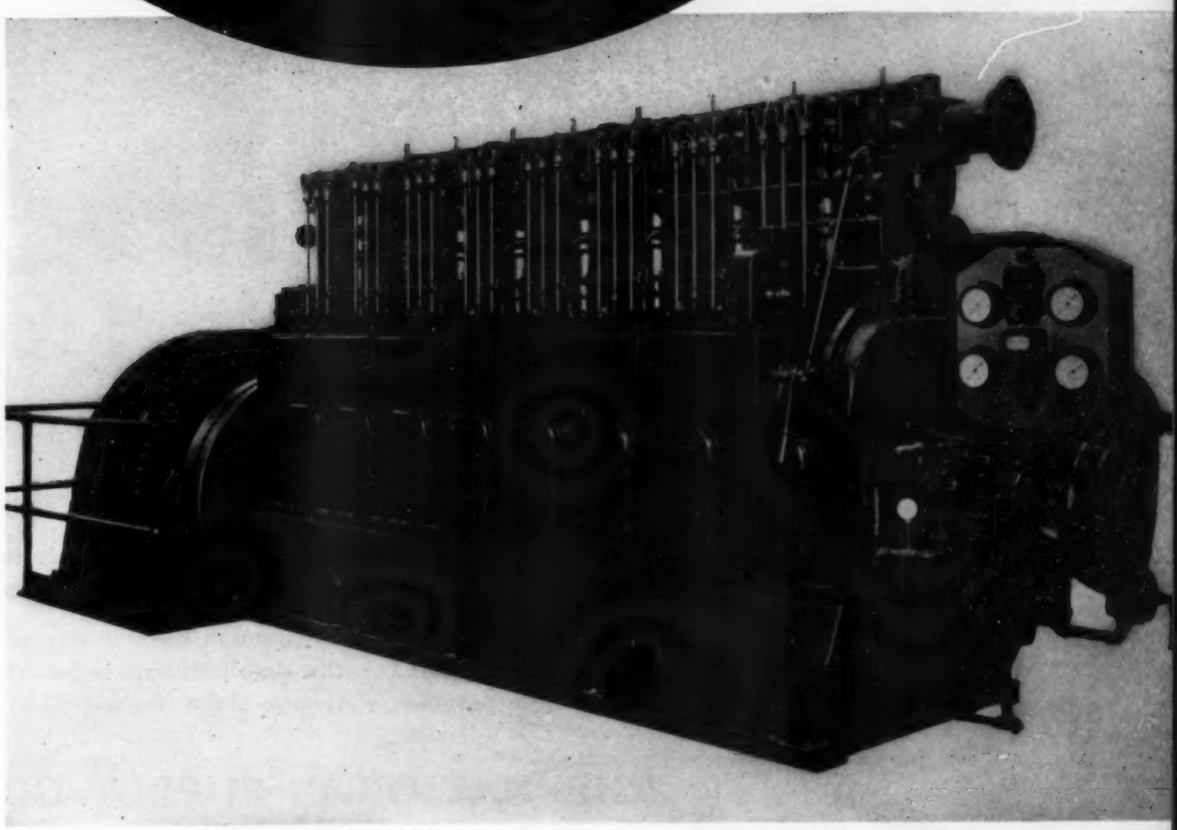
E R I E

An Erie crankshaft selected by Enterprise Engine Corporation for this eight cylinder, 450 H.P. 300 KW Diesel engine generator set recently furnished to the U. S. Army Engineers at Fort Peck, Montana.



Dependability and long life, proved in innumerable marine and stationary installations, account for the repeated use of Erie equipment by leading engine builders.

Rough and finished connecting rods, piston rods, crossheads, generator and extension shafts for all classes of stationary and marine engines. Complete facilities for prompt delivery on all major forged or cast steel elements required in the building and powering of every type of construction.

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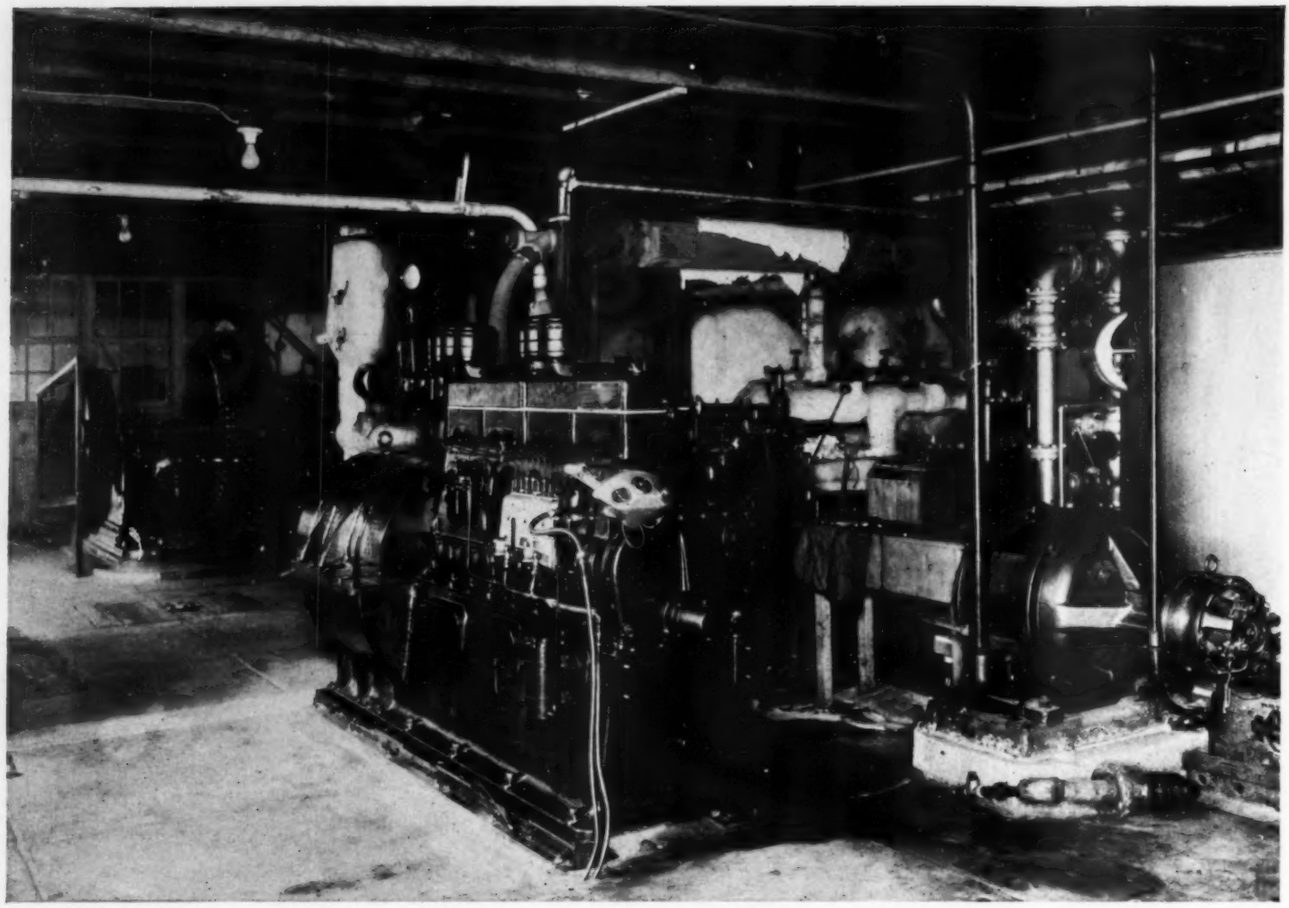

Superior Diesel Generating Unit owned by The White Star and Pitman Laundry, Pitman, N. J.

The economy and reliability of the Superior Diesel engine is being conclusively demonstrated in this laundry installation.

A Superior Model GA-8, 60 K. W., 1200 R. P. M., Electric Generating Unit provides the White Star and Pitman Laundry with a low cost source of power.

Unattended installations of this type require the simplicity and reliability that are characteristic of the Superior Diesel.

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OF DELAWARE

SUPERIOR ENGINE DIVISION, SPRINGFIELD, OHIO

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Superior DIESELS

HEAVY DUTY MODELS: 50 to 810 H.P., 250 to 720 R.P.M. • HIGH SPEED MODELS: 15 to 150 H.P., 900 to 1800 R.P.M.

MAXIMUM COMPRESSION
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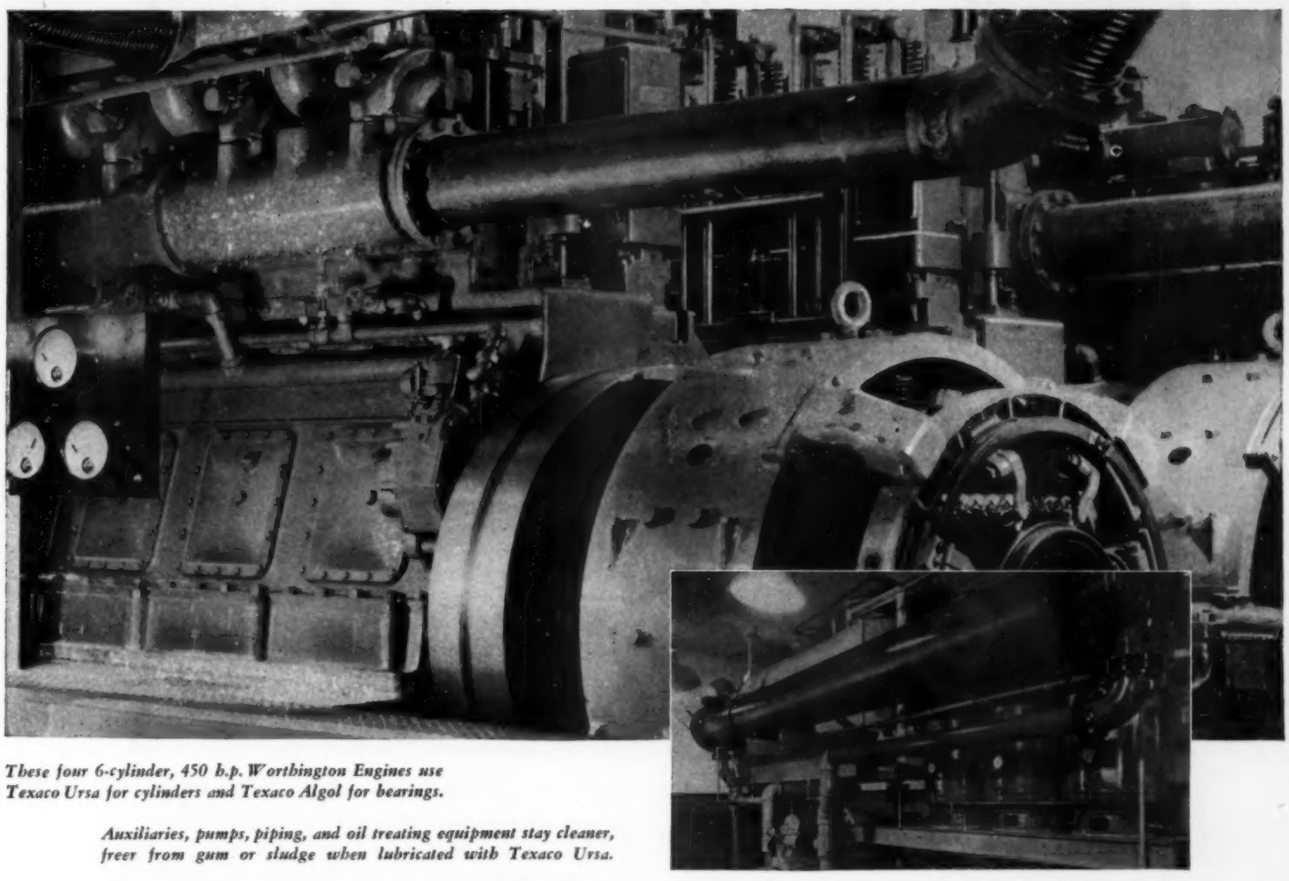

These four 6-cylinder, 450 h.p. Worthington Engines use Texaco Ursa for cylinders and Texaco Algol for bearings.

Auxiliaries, pumps, piping, and oil treating equipment stay cleaner, freer from gum or sludge when lubricated with Texaco Ursa.

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Trained lubrication engineers are available for consultation on the selection and application of Texaco Diesel Lubricants. Prompt deliveries assured through 2070 warehouse plants throughout the U. S.

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Smooth, effortless starting on upgrades—even with heavy loads—is easy for Hercules Diesel-powered Twin Coach buses operating on the Chestnut Hill run of the Boston Elevated Railway Company. The first of these buses was placed in service more than a year ago. Four more have recently been added—all equipped with Hercules DRXB Diesels. A wide speed range, minimum weight per horsepower, clean combustion and economical, efficient performance give Hercules Diesels unquestioned leadership in the field of bus transportation. Manufacturers of all kinds of equipment requiring heavy-duty, high-speed engines—either gasoline or Diesel—find Hercules well equipped to supply their demands.

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WITH SKF BEARINGS

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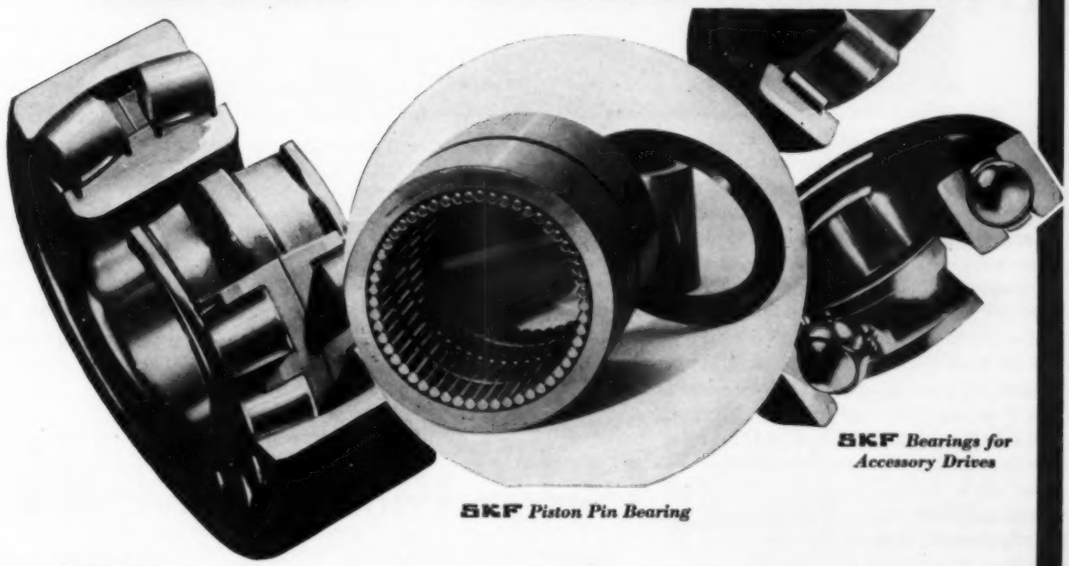

SKF *Bearings for Accessory Drives*

SKF *Piston Pin Bearing*

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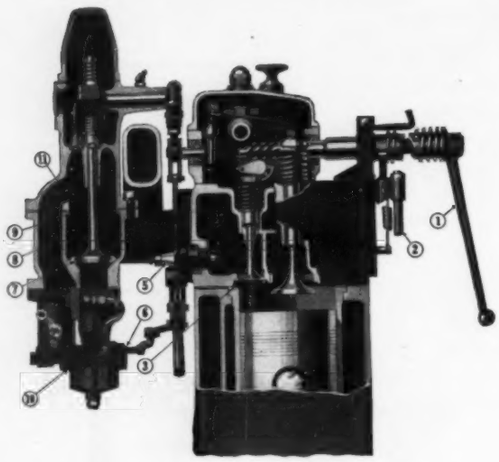
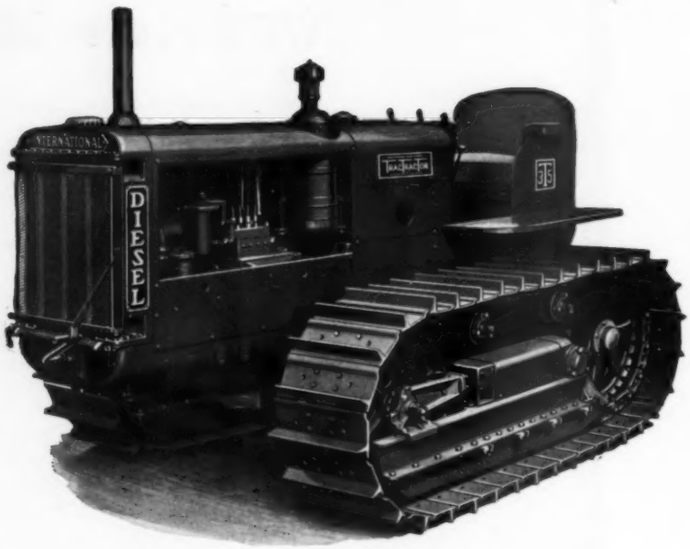
INTERNATIONAL *Announces* a New DIESEL TRAC TRAC TOR

THE popular features which have won an enviable position for International Diesel-powered tractors and power units are now available in the **new** Model TD-35 DIESEL TracTracTor. Following the design of the larger Model TD-40, this new Diesel TracTracTor brings you the many advantages of the International Diesel Engine in a somewhat smaller tractor at a lower price. The TD-35 is a true Diesel—in design, performance, and economy—yet it starts on gasoline and converts itself automatically to full DIESEL operation after warming up for one minute or less.



THE International TD-35 DIESEL TracTracTor can be started as readily as a gasoline engine of corresponding size. In starting the engine, the operator turns the crank (1) which opens valves (3) to the auxiliary combustion chamber (4). Spark plug (5), one for each cylinder, is located in these auxiliary chambers. The crank also opens the gasoline shut-o'f valve at (6), and lifts the poppet-type air valve (7) to its upper seat (8), closing off the inlet of air from the air cleaner and shunting the air through the passage (9) into the carburetor (10) where it mixes with the gasoline, carrying the mixture into the intake manifold at (11). After the engine has made 700 revolutions, rod (2) releases the shaft turned by lever (1). When released, springs close valve (3), disengage the magneto and turn the poppet-type air valve (7). The engine then operates as a full Diesel.



IN addition to its DIESEL engine, the International TD-35 also features variable-speed governor; 5-speed transmission; ball bearings at 43 points; replaceable cylinders; Tocco electrically hardened crankshaft; special dust seals; fuel strainer; air cleaner; oil filter; and unit construction throughout. With this type of construction, important working parts may be removed as units, enabling the owner to make adjustments or replacements in the shortest possible time. This important time-saving feature keeps maintenance costs down.

This new International DIESEL TracTracTor is already serving many branches of industry, adding to the reputation built up through the years by other International DIESEL wheel and crawler tractors and power units. The nearby International industrial dealer or Company-owned branch will supply complete details on request. Or write us for information.

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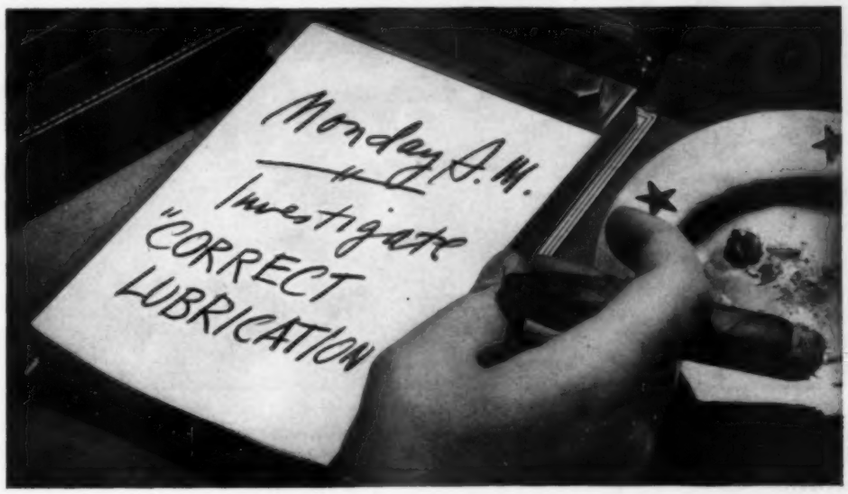

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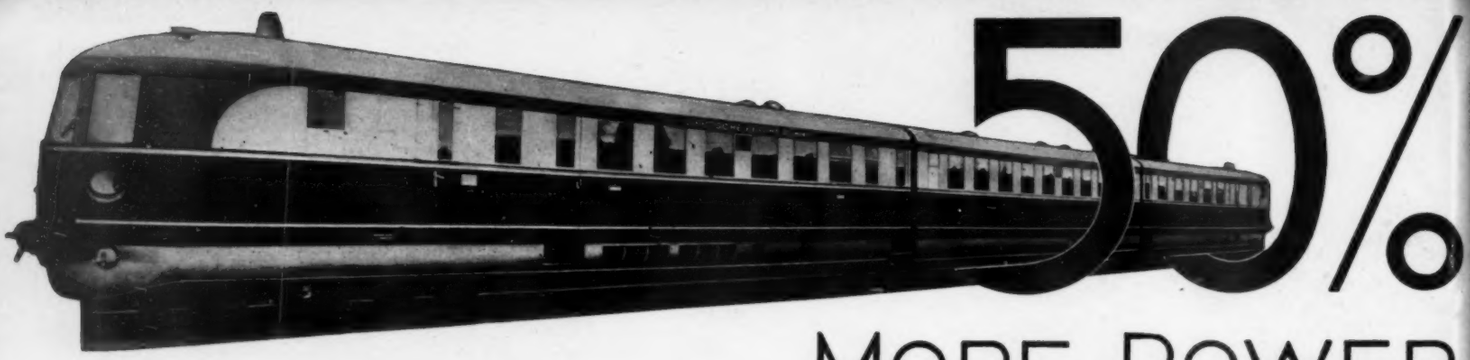

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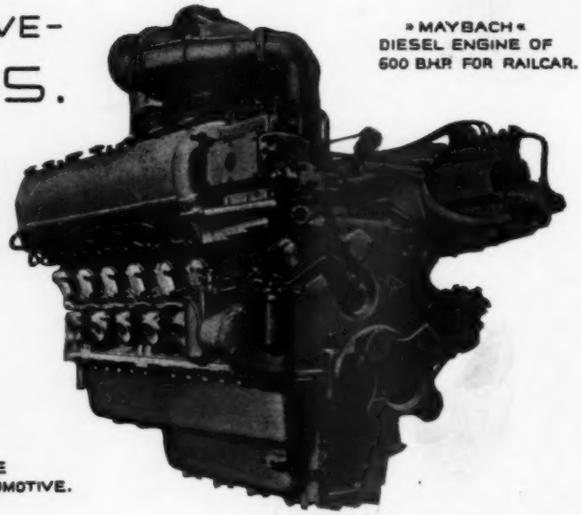

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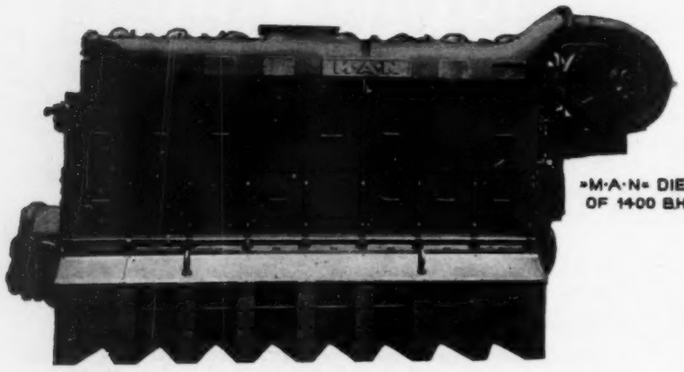

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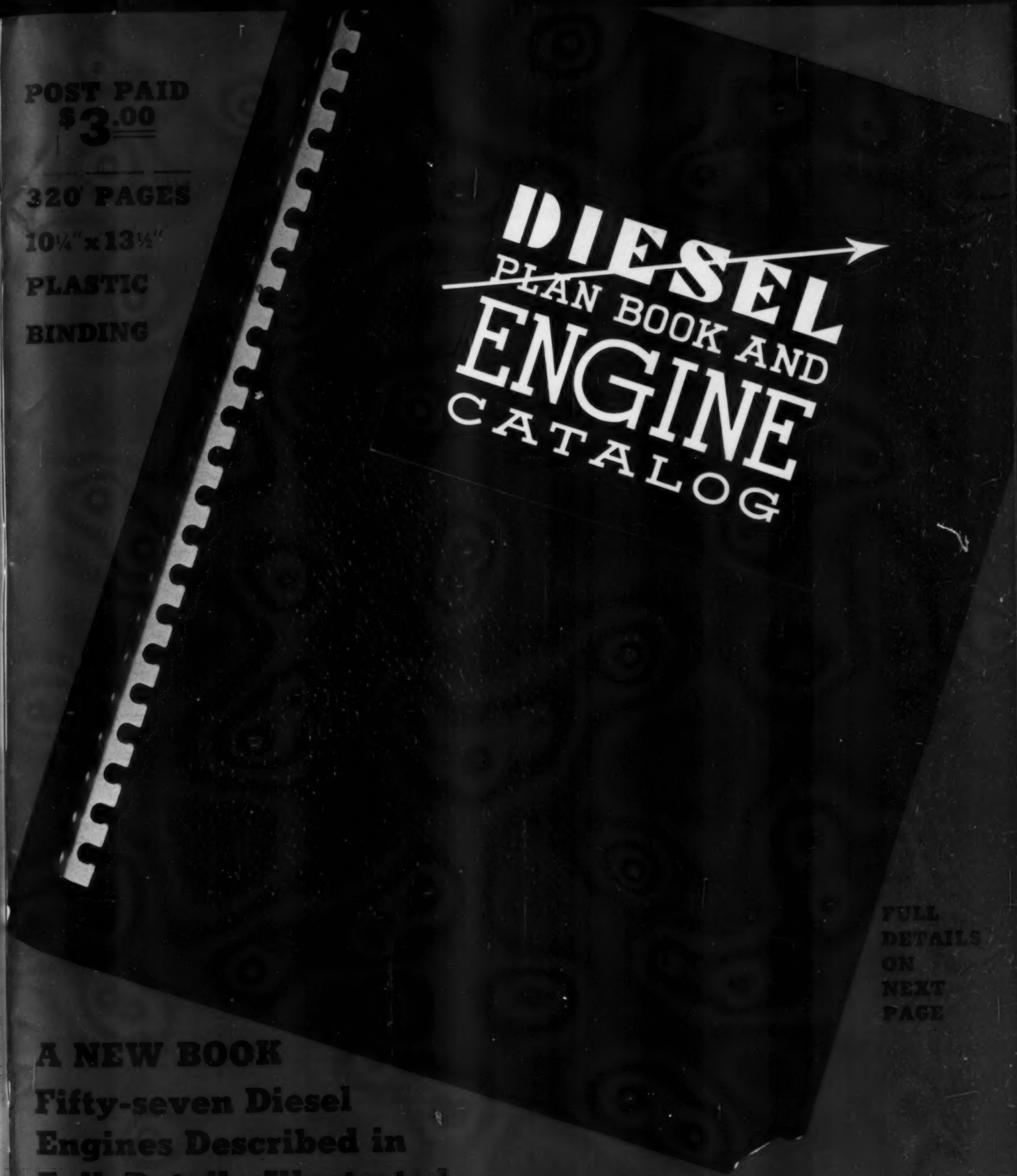

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(1) The Birth of the Diesel Engine
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(3) Noise Elimination
(4) Flexible Connections
(5) Air Filtration
(6) Ponca City, Okla.
(7) Department Store Application Study
(8) Port Clinton, Ohio
(9) Sailors Snug Harbor
(10) Chicago Diesel Fire Boat
(11) 580 Fifth Ave., New York
(12) Mobile Ice Plant
(13) New York University
(14) Parke Davis Company
(15) Imperial Irrigation District
(16) LaPorte City, Iowa
(17) 8000 kw. Shanghai Plant
(18) 15,000 kw. Hydro Standby plant
(19) 22,000 hp. Mine installation
(20) Combination Hydro-Diesel-Steam
(21) French Community installation
(22) Paris, Texas, Observatory
(23) Langbein Cutlery Company
(24) U.S. Coast Guard vessel

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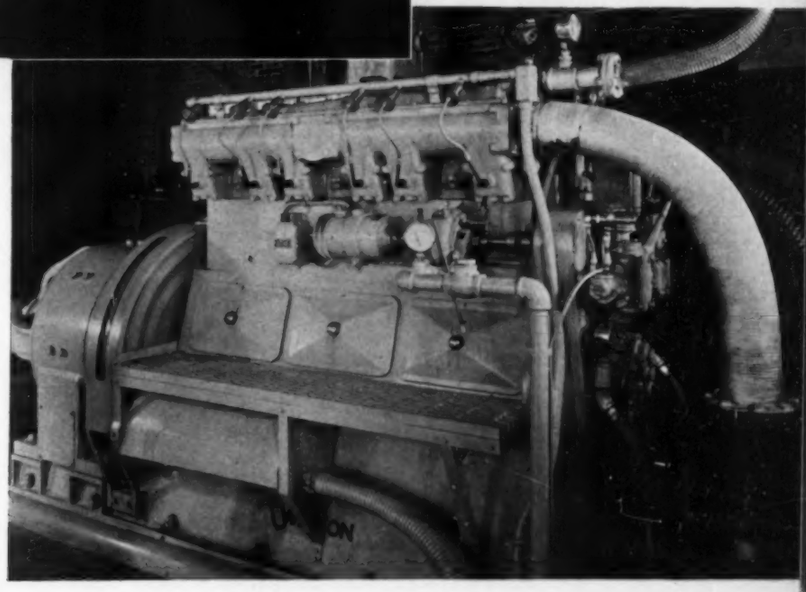
(Above) McDonald Observatory of the University of Texas, located 16 miles from Fort Davis in West Texas, atop Mt. Locke, 6,900 ft. above sea level. Telescope equipped with 82-inch diameter mirror.



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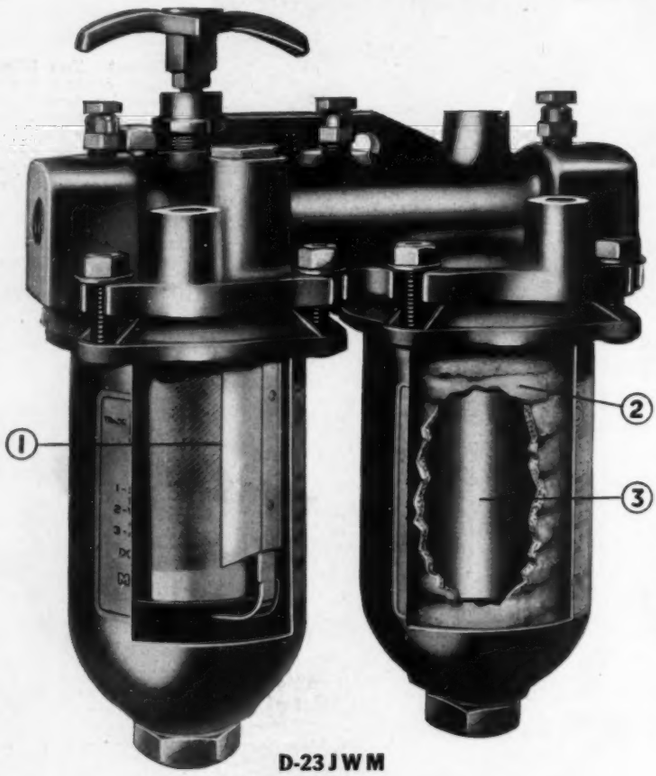

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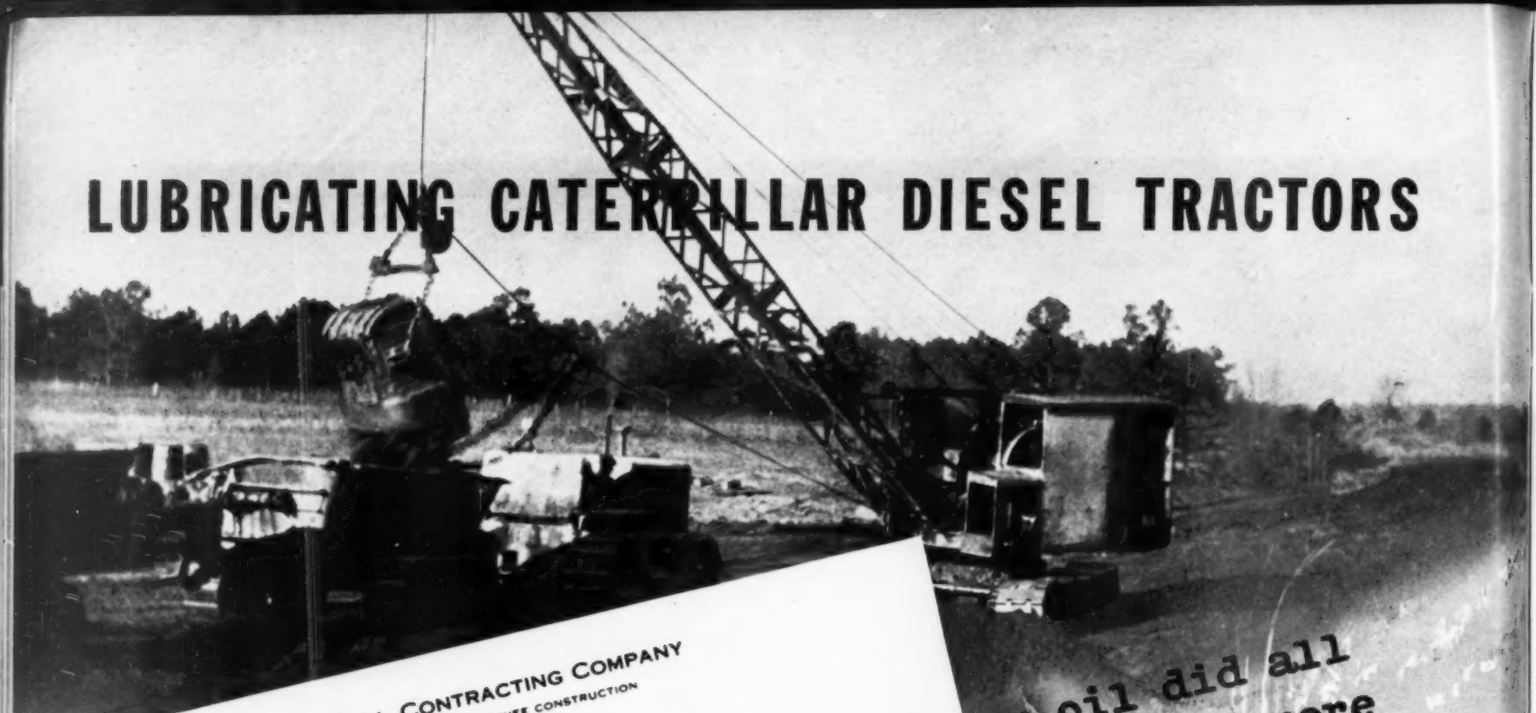

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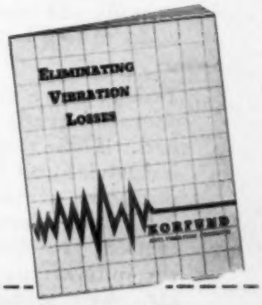

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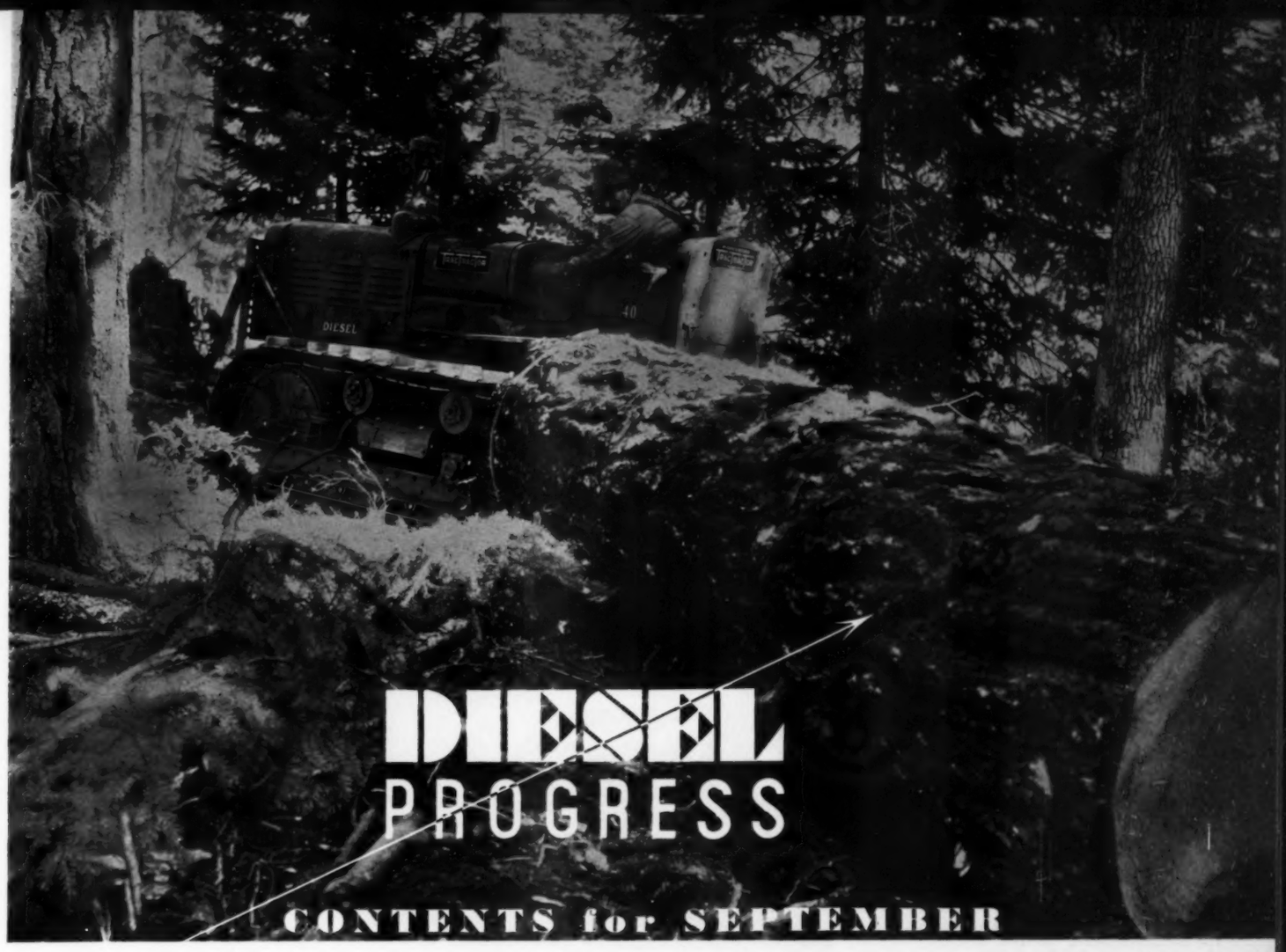

DIESEL PROGRESS

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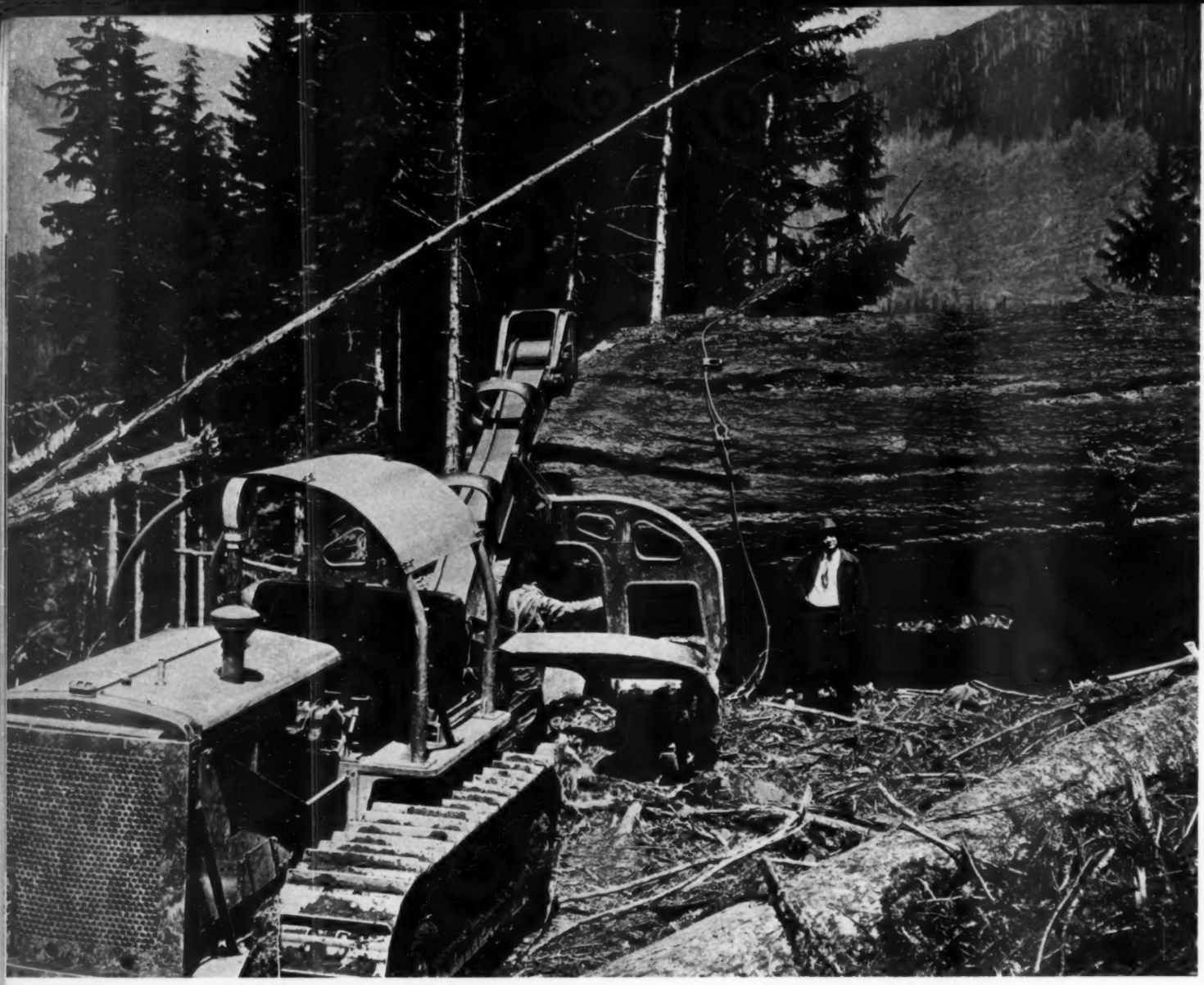
FRONT COVER ILLUSTRATION—Our front cover this month carries no Diesel engine but rather graphic evidence of where one has performed a difficult job successfully and economically. The pictur shows part of a five-mile stretch of the West Fork Logging Company's new railroad grade through an Oregon forest. This road bed was entirely prepared by a Caterpillar RD 8 Diesel tractor with bulldozer.

TABLE OF CONTENTS ILLUSTRATION — McCormick-Deering TracTracTor powered with International Harvester Diesel TD 40 skidding logs near Mt. Adams, Washington. This unit skids logs, such as the one illustratert, over an approximate distance of 1000 feet from the point of felling to the point of loading. Much of the distance is up and down steep inclines. Daily cost of fuel averages $1.40.



LOGGING THE WESTERN MOUNTAINS WITH DIESELS

By CHARLES F. A. MANN

Many of the photographs used in this article are from the personal file of Mr. L. T. Murray, President of the West Fork Logging Company of Tacoma, Washington. Grateful acknowledgement is made herewith for his courtesy and cooperation. Mr. Murray appears above, watching one of his Diesel tractors snaking out a 14-foot Douglas fir. The Editor.

THE Age of Steel, due to a vast publicity campaign, has now somewhat overshadowed the Age of Wood, but, in this booming year of 1937, the vast logging industry of North America is enjoying one of its greatest periods of prosperity. A whole mighty industry, linked with America's heroic past, is stepping out with a brand new line of attack. Old practices are fast going into the discard and a brand new frontal attack laid out on amazingly scientific lines, is being made on our timber supply. But, fortunately, this highly mechanized business of bringing down millions of feet of logs per day, is proceeding at last, along lines that will positively assure America a perpetual supply of the finest timber, and guarantee permanence to the host of new wood-consuming by-products industries that are being started each month.

Caterpillar tractor and Hyster logging arch dragging a 6-ft. Douglas fir log.

About 15 years ago the snorting, wood burning, clumsy steam donkey engine, requiring two men to cut firewood to keep it going, suddenly heard the roar and snort of a caterpillar tractor cut short the shrill whistle blasts that had run undisturbed through the Big Woods for nearly a half century. A few years later with its roar somewhat deepened and softened, the Diesel engine displaced the gas engine in this tractor. At first, side by side, the Tractor and the steam Donkey snaked the trees from where they fell in the woods, to the railroad cars. The donkey, with its miles of steel rope rigging hitched to a tall Spar Tree, and the Diesel Tractor, with its short line of cable and Cruiser-Arches, raced the timber to railhead on a sort of competitive basis. Oldsters in the woods still jerked the levers on their steam donkeys, and gradually, especially on the West Coast, the two sweating young lads that cut firewood for its belching boiler mounted on the wooden skids, behind the double drum donkey winches, disappeared, and oil for fuel took the place of woodcutters. The oldster ran his machine efficiently enough, but those twenty-three year old lads, green in the Big Woods, jerked their 20 ton tractor gear around with amazing speed. First 10,000 feet per day from woods to railhead, then 15, 20, 30, 40 and on up to 75,000 feet in eight hours, came rolling down the hills behind the booming Diesel tractors.

A new era in the logging industry had dawned just before the big smash in 1929, and even before Mr. Hoover's boys began calling for Forest Conservation.

After a century and a half of cutting American forests, the perfect answer to just HOW to save our timber came with the advent of automotive equipment, and its gradual replacement of the old steam gear.

Logging, it must be remembered, is the basis of the lumber industry, the pulp and paper business, the Rayon and Cellophane output, the raw material for shingle roofs, plywood panels, doors, window sash and that 2 x 4 you ordered to make a workbench frame in the back of your garage. Logs are the iron ore of the forest industries.

Since trees were first cut down in Asia, 40 centuries ago, the man with the axe, stone or metal, and later the man with a big crosscut saw was, and still is, the basic part of logging, and the business of felling trees has remained essentially the same throughout the centuries. Out in the far North Pacific region, where trees range from 18 inches to 15 feet in diameter, the *average* being in excess of 4 feet, this felling business is a rather heroic job. Once felled, the big logs are trimmed of branches and sawed up into 20 or 30 foot lengths, just the size to load on to a railroad flat car, and weigh from 3 to 12 tons each.

Since steam donkeys replaced most of the sledding on winter ice and the long teams of horses pulling heavy chains, the "old reliable" method of snaking these logs to the railhead for shipment has been via the end of a steel cable line. At the base of a tall spar tree, that naked monster all rigged up with bracing cables, pulleys and lines you see whenever logging is mentioned, the steam donkey did the work. One of its two drums hauled the logs in from a 2,000 foot radius in a circle around the rigged-up tree, while the other hauled the hooks back to the woods for another load of logs. Obviously it was necessary to cut down the forest clean when using the expensive method, because you had to clean it up entirely with one setting, or go broke wriggling the logs around the unfelled trees. The idea was to saw down everything in sight and take what you could sell, leaving the piles of smaller stuff to rot in the woods, or cause forest fires in the dry season. The vast acreage of cutover land that causes the logger to squirm when public sentiment gets roiled up, is the result of that old-time practice, a method absolutely necessary in the old days of logging.

The McCormick-Deering Diesel TracTracTor shown is one of a pair operated by two partners in the Pacific Northwest. Such a combination is typical of small logging operations. Two or three men invest in one or two Diesel tractors and several trucks. They then hire fallers, bunchers, choke setters and truck drivers. The Diesels perform double duty in skidding out logs to the trucks, as well as keeping the roads for the trucks in condition. Average cost of skidding logs for the above unit is less than 5c per 1,000 ft. of logs moved.

200-hp., 6-cylinder, Washington Diesel yarder rigged to a spar tree, cold decking fir logs from a 1,600 ft. haul in opposite directions.

But with the advent of the Diesel into the woods all has changed. Dozens of large timber companies are gradually replacing their high lead logging methods with Diesel tractor logging on either a full of partial selective basis — that is, taking only the ripe trees and leaving the younger ones to grow another half century or so. Many companies are abandoning their steam equipment altogether. Many use Diesel truck-tractors to make long hauls with loads of logs direct from woods to log pond at the sawmill. No region in America has been quicker to adopt this costly, highly efficient and very economical new equipment than the big league loggers in the far West, and no more right-about face from a destructive old practice to a sound, constructive new industrial practice exists in any American business than does in the logging industry.

The best example of the side-by-side use of every method of logging, in a varied and extremely rough country, where Diesels, wood burning steam, oil burning steam, Diesel donkey engines and all the rest work over a very large area, is to be found out on the west foothills of the Cascade Range in Washington State. Just south of Rainier National Park is a compact area of nearly 200 square miles under the controlled operation of the West Fork Logging Company, headed by dynamic, far-sighted logger, Lowell T. Murray. Mr. Murray began logging 25 years ago and, along with the Weyerhauser Timber Company, operating in three states, the Simpson Logging Company, the Crown Willamette Paper Company and a few others, has actually put into practice the long dreamed of idea of "selective logging." This method alone is the answer to future American forests, and when used in combination with other types of logging for difficult areas, means that a large, controlled area can be logged over once every 75 to 100 years, with a perpetual harvest of good trees, minimum danger from forest fires, minimum expense of moving from one area to the other, and selected use of various types of trees for specific purposes. A whole story can be written on the economical use of trees. Sometimes hemlock gluts the market and can't be sold at any price. Sometimes giant fir "peeler logs" for the veneer plants bring fabulous prices on a scarce market. Sometimes long clears are premium logs and so on. Taxation on heavy stands of timber is still excessive. But clean logged off land is useless for taxation. The proper economic setup is to equalize all these factors and operate logging, not as a migratory tramp industry, "grab all and scram," as the loggers did of old, but to SETTLE DOWN AND HARVEST TIMBER AS A CONTINUOUS CROP.

And that's what Logger Murray and a few far-seeing timber people have already begun to do on a huge scale!

And there is no other way to do it except with Diesel automotive equipment to snake the ripe trees out, leaving the younger and smaller trees to pick up later — perhaps after the present operators are dead and buried! ! !

In the West Fork setup you have the whole forest-logging problem all in one package. At the midpoint of the old reliable logging railroad we see two Diesel tractors hauling 20,000 pound loads of giant logs down 15 per cent skid roads to the loader, then tearing back up the hill for another load. Two tractors get out 60,000 feet per day, with one young man at the wheel of each, and a few helpers at each end of their half-mile run. REMEMBER THAT THE BEST HIGH LEAD DONKEY OPERATION IS LIMITED TO ABOUT 2,000 FEET. And soon these tractors will go back a mile and a half into the woods.

Look around and the "logged off land" here is almost as thickly covered with trees as if nothing had been taken out of it! Yet Mr. Murray says 60 per cent of the cubic contents of this forest has been logged off, leaving the thriving 40 per cent with plenty of sunlight and good prospects for a future forest that won't be swept by forest fires. Thanks to the Diesel tractor that can back up to a tree, a foot or two to spare between the standing trees, and neatly yank it down to the rail siding without harming a bit of standing timber!

A few miles higher up, at the 3,400 foot level, another new railroad branch turns up a rushing creek. A mile up this siding two Diesels, with their 6 cylinder 125 hp. engines roaring madly, are busy cutting a 12-foot roadway through the jungle that grows in these Northern Tropics, up a 20 per cent grade, to start opening a new 160-acre "Quarter" for the start of logging operations next week. With an air operated bulldozer blade in front and a skilled operator, it is possible to penetrate nearly one-half mile per day into the densest of woods.

Later more Diesel tractors with Hyster Cruiser-Arches will come along and start moving the felled trees down this trail. These units have a double-drum winch mounted behind, to reel in the logs and hoist them to the top of the cruiser.

In another section of the woods a 200 hp. Washington Diesel Yarder (donkey engine), with air clutches, operates a high lead rig to move timber off a section where it won't pay to use selective logging. In the high country fuel costs 7 cents per gallon and you can run a Diesel yarder for one-quarter what it costs to fire a steam driven rig. In still another section we find a Caterpillar tractor, with double drum donkey rig, mounted and anchored to big logs and stumps, used directly as a "cold decking" rig – where logs are piled for further hauling to railhead. A portable donkey engine is the Caterpillar when rigged this way.

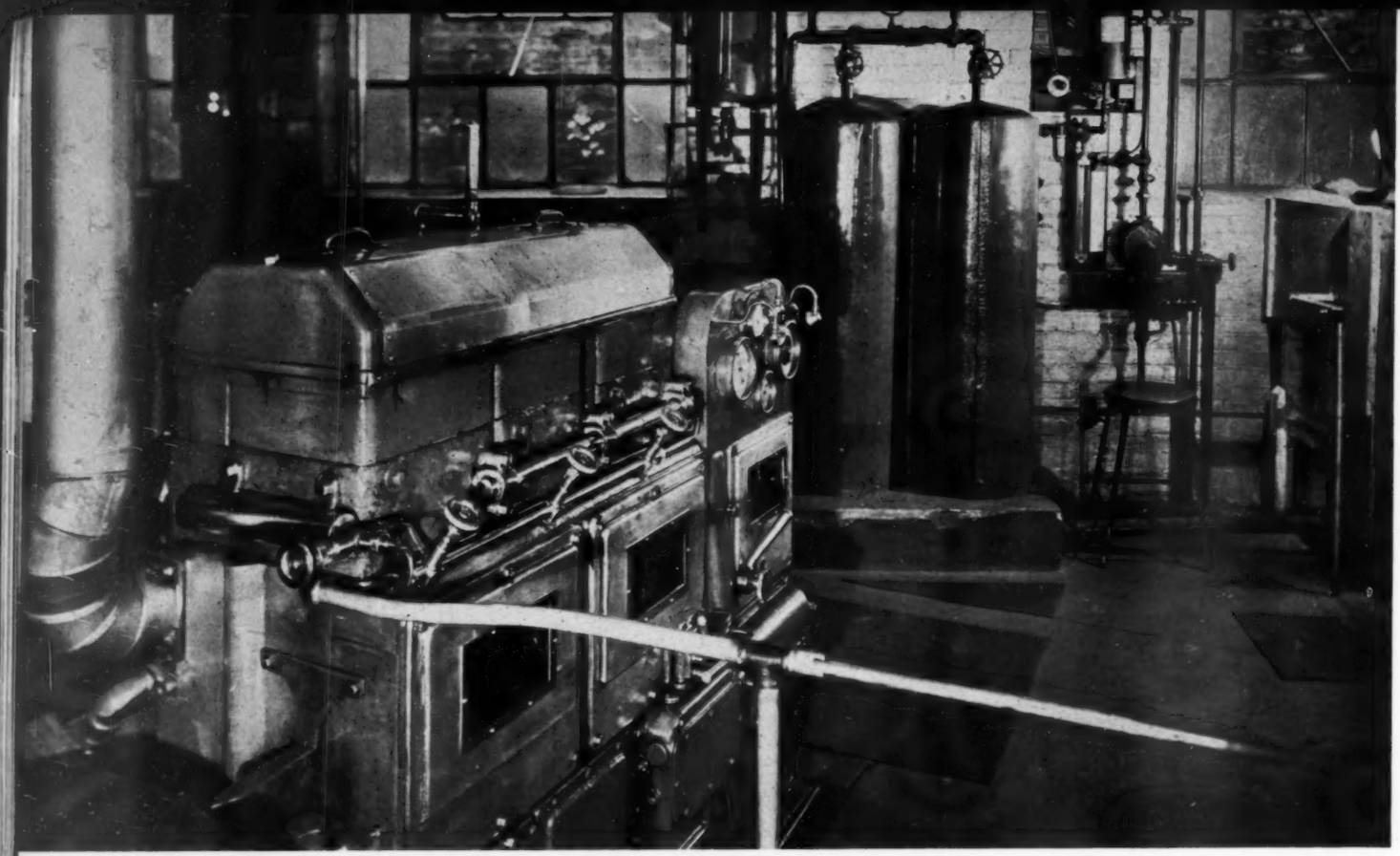
Farther up a fleet of four or five booming Caterpillars, using a heavily traveled skidroad in soft dirt, bring down 200,000 feet of logs per day. And beyond, an old-time steam donkey snakes logs off a plateau-edge. where trac-

. . . . *And now please turn to page 58*

Allis-Chalmers type LO Diesel tractor equipped with cable winch operating on holdings of the Red River Lumber Co., West Wood, Calif.

Another Allis-Chalmers LO Diesel tractor in South Oregon skids on the average of 40,000 board feet per day with a fuel consumption of 24 gallons.

Below: International powered TracTracTor near Husum, Washington, not only greatly reduces the cost of skidding logs out of the forest but, according to the owner, has the additional advantage of eliminating the fire hazard which accompanies gasoline tractor operation.



The Cooper-Bessemer Diesel which supplies all of the power for the Langbein Cutlery Company of Brooklyn, N. Y. Note the Petrometer remote reading fuel tank gauge to the right of the air tanks.

LANGBEIN CUTLERY

AN interesting Diesel installation that is more than proving its worth is located in the Brooklyn factory of Langbein Bros. This is an old established business for manufacturing cutlery and surgical instruments. In addition, considerable job work is done, such as sharpening knives and cutters of all kinds. All of this calls for a high grade of workmanship, and one has but to walk through the shop and see the equipment and watch the manufacturing operations to realize that the company is well set up to turn out only the best in those lines. This background explains the care and interest bestowed by the owners upon the Diesel installation and its operation.

The factory itself is a two story and basement building with the forge shop in a separate building adjoining. And also alongside is a gift shop operated by the same owners. Thus there is a considerable demand for power and light. Prior to three years ago, much of the power was supplied by a single cylinder horizontal White and Middleton gas engine using city gas for fuel. This engine did its duty for seventeen years and still is available as a standby in case of failure of the Diesel engine. So far, this gas engine has not been called upon to do substitute duty, and this is fortunate because it could not handle the present load.

When the gas engine was doing regular duty, it carried only the load for the machine shop through a belt drive and line shafting. The forge shop was run by a 20 hp. motor, and the current for this as well as for lights and other purposes was purchased from Edison. When the Diesel was installed three years ago, it was connected by belt drive to the main countershaft in the basement, which countershaft had been driven by the gas engine, and the forge shop shafting was connected to the machine shop shafting by a mule drive (a right angled belt drive) to suit the existing lines of shafting. Then, in order to supply electrical energy, an alternating current generator was installed, driven by belt from the main countershaft. In spite of the fact that the Diesel is rated at about 65 hp., at 450 rpm., it is carrying all of the load formerly carried by the 50 hp. gas engine, the forge shop motor, and it carries the lights.

The machinery is installed in the open basement, and the remainder of the space is occupied by the nickel plating baths, the forge die storage, and the electrician's shop. In fact the electrician is also the engineer. He gives the Diesel attention once an hour and records his readings on the log forms. One of these forms makes the ampere readings show as curves. And above his bench, constantly in front of him while he is there, is a voltmeter which is a good indicator of normalcy of operation.

The Diesel engine itself has a history. It is a three-cylinder, four-cycle Cooper-Bessemer Diesel of their type EP with cylinders 7½" by 10½". The common rail fuel injection system is used with the well known atmospheric relief valves. Fully enclosed, all parts are lubricated by the pressure lubricating oil system.

It was originally installed in 1931 to supply power and light to a religious colony settlement in upstate New York. At that time it was direct connected to a generator. It ran at very light load for several months, and the failure of the settlement left the engine idle.

Two years later it was purchased and installed in Hastings, New York, to supply power and light to some stores and loft buildings. The engine operated in this service for less than a year, but during that period was heavily overloaded.

Then it was purchased by Langbein Bros. to cut their cost of power. Since the original installation, many little attachments and devices have been added to improve the appearance and help the operation, until today it is unusually complete and is a show piece.

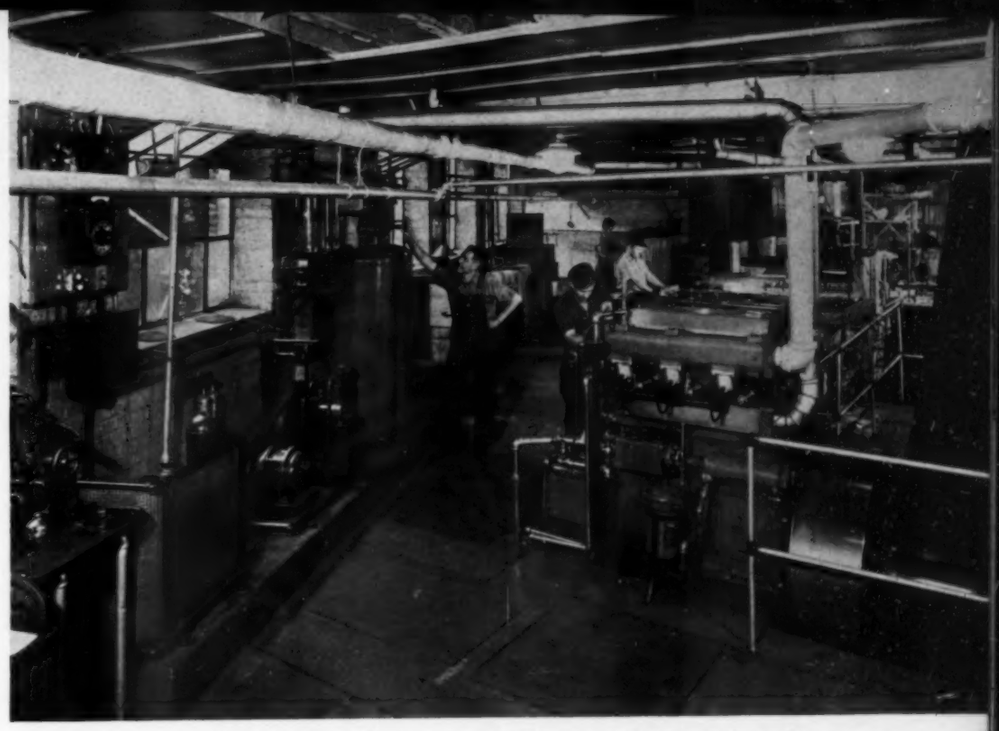
The engine is installed with the supporting flanges along the sides of the bedplate at floor level. This brings the crankshaft center a few inches above the floor, and the top of the engine about 4½ feet above floor level. Thus even the top parts are easily accessible. The bedplate is bolted to steel I beams set into the concrete foundation block of 12 cubic yards content. There is no sign whatever of vibration anywhere around the engine.

A new extension shaft was fitted to the engine for the heavy flywheel and for the 16" belt drive to the countershaft diagonally overhead. The countershaft pulley has a clutch. The engine shaft rotates so as to bring the tight side of the belt on the bottom. Beyond the pulley on the engine extension shaft is the outboard bearing of the roller bearing type.

The generator is driven from the other end of the countershaft, and since, in plan view, it is on the same side of the countershaft as the engines (the gas engine is between the Diesel and the generator) the tight side of the belt is on the top. There is a weighted belt tightener, confined by slides, on the top of this side. The generator is a 50 kva. General Electric 225-120-volt, 60-cycle, 3-phase machine with direct connected exciter mounted on the end of the generator. This generator, therefore, furnishes electrical energy of the standard Edison characteristics. The switchboard is adjacent to the generator in a corner of the basement, and there is a voltage regulator on the board in addition to the regular instruments. The net result is that the lights burn very steadily under all conditions. This generator furnishes energy for the motor generator set, for the nickel plating baths, for the welder, for some small motors, and for lights. The only power purchased from Edison is for lights at night or when the factory is shut down, and for direct current for the magnetic chucks on the machine tools.

Air for the engine is taken through a Staynew filter located in a depressed alley alongside the basement. This alley provides light and ventilation for the basement and is covered by a grating. The location of the air intake plus the general atmosphere in that vicinity makes the use of a filter quite necessary.

The exhaust from the engine was turned into the old gas engine exhaust pipe, which leads along the upper part of the basement and up to the roof. There is no silencer in the line, but the length of the pipe line is something like 150 feet, with the result that the exhaust noise is completely silenced. What back pressure there is has no noticeable effect on the engine performance. In order to prevent the Diesel exhaust gases from getting back into the gas engine, a steel plate has been fitted between the flanges in a joint of the branch line to the gas engine.

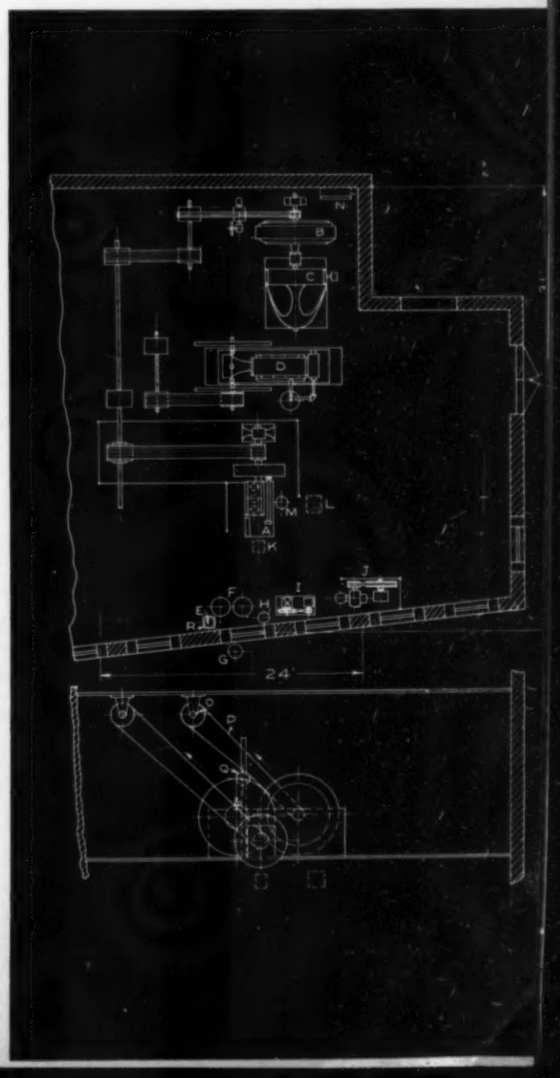


General view of the engine room showing the main belt power take-off and the cutlery plating equipment in the background. Charles Langbein appears at the extreme left.

Fuel is stored in a 1,080-gallon tank buried in the yard adjacent. A Petrometer on the engine room wall indicates the amount of fuel in the tank at all times. The tank is filled from tank trucks at the curb with the hose taken to the filling connection. A motor driven Teasdale pump unit draws from storage and delivers through two strainers in series to the 10-gallon day tank high on the engine room wall. The pump is controlled by a float actuated switch to maintain a nearly constant level. Even a drop in level of ¾" rings an

Legend

A—Three cylinder four cycle 65 hp. 450 rpm. Diesel engine.
B—Alternating current generator.
C—Direct connected exciter.
D—Gas engine.
E—Fuel transfer pump.
F—Starting air storage tanks.
G—Air intake filter.
H—Fuel oil day tank.
I—Starting air compressor unit.
J—Circulating water pump.
K—Lubricating oil sump tank.
L—Cooling wate- sump tank.
M—Lubricating oil filter.
N—Switchboard.
O—Countershaft.
P—Belt drive.
Q—Belt tightener.
R—Petrometer for indicating fuel quantity in storage tank.



alarm. And there is a red light to indicate that the pump is running, and a green one to indicate it is shut down. Between the day tank and the pressure pumps on the engine, there is another strainer; and there are two more strainers on the engine. Finally, there is a high pressure strainer on the line to each cylinder. Thus the number 2 Gulf fuel used is strained six times, and operating troubles from dirty fuel are eliminated.

Socony-Vacuum DTE extra heavy lubricating oil is used in the pressure system. The oil drains from the engine bedplate to a sump tank located in a pit at the end of the engine. The engine pump takes it from there and delivers through a strainer on the engine, a Nugent filter outside of the engine, a cooler on the engine, and to the bearings. The filtering process is so thorough that the oil remains clean without further attention.

Cooling water flows in a closed circuit. The overflow from the exhaust header jacket is into an open funnel, to break the syphon effect, and to a sump tank alongside of the engine. A motor driven plunger type Goulds pump takes from the sump and sends the water to the top of the cooling tower on the building roof. The water flows by gravity from the basin under the tower through the engine jackets. The outlet temperature from the engine jackets is maintained at about 125 degrees F, and the temperature rise through the jackets at from 15 to 20 degrees. At night, all of the water in the cooling tower is drained to the sump in the engine room, so that there is never trouble from freezing in the winter time. The engine jackets are always full of water. There are high water temperature, and high and low water level alarms on the system.

Starting air is supplied by a motor driven two stage air cooled Globe compressor, ad is stored in two tanks at 250 pounds pressure.

In addition to the equipment items already mentioned, there is a low lubricating oil pressure alarm, and a Brown exhaust pyrometer. But among the most interesting items of the installation are the little improvements made by the owners. They have been added individually from time to time, and the owners still seek further items. For instance in the covers on the front of the engine that enclose the fuel injection system atmospheric relief valves, glass windows have been fitted so that these parts can be easily watched at all times without touching the covers. The exposed piping on the engine has been chromium plated. Special lights have been added to illuminate the gauge board.

The engine is just as carefully inspected as it is operated. The distance between crank-webs is checked once a month to make sure of the main bearing alignment. The several cleaners, strainers and filters are inspected and cleaned regularly. The fuel injection system valves and parts are inspected and tested every few months. A Watson Stillman hydraulic pump has been rigged up for this latter purpose. Inlet and exhaust valves are inspected once a year. The exhaust is perfectly clean at all times, and the temperature runs about 600 degrees. There are no carbon formations inside of the cylinders, and a general overhauling has not been undertaken since installation.

The results of all of this background are inevitably reflected in the economy of operation. Lubricating oil consumption is less than one quart for a nine hour day. From 30 to 32 gallons of fuel are used per day. The engineer, Michael Braccio, is the shop electrician as well as engineer. Total cost of supplies and spare parts used during the past three years is estimated at less than fifty dollars. The items include only some packing, small springs, fuel relief valve parts, and a piece of fuel injection header. And the old header has been repaired and is available for use again. Naturally, all repair work possible is done in the shop.

The work of installation was done by Harry Davis. The owners have every reason to be proud of this installation—its appearance, its record of dependability, and its economy.

One of the two floors full of machinery which is all driven by the three-cylinder, Cooper-Bessemer Diesel.

MOTOR TANKER MERCURY

By JOHN W. ANDERSON

AN interesting Diesel driven tanker has just been placed in service by Cleveland Tankers, Inc. Designed by George B. Drake and built by the Pennsylvania Shipyards at Beaumont, Texas, the steel hull is all electric arc welded. The vessel is built on the Isherwood Bracketless System to Lloyd's Classification for short coastwise and Great Lakes trade, and is intended for service as a bulk oil carrier from the Great Lakes through the New York State Barge Canal and along the Coast.

Length over all	258 ft. 0 in.
Length between perpendiculars	251 ft. 3 in.
Moulded beam	43 ft. 0 in.
Moulded depth	16 ft. 6 in.
with a 2 ft. 6 in. expansion trunk over the tanks.	
Total cargo tank capacity	22,388 42-gal. bbls.
Diesel engine fuel capacity	304 42-gal. bbls.
Boiler fuel capacity	161 42-gal. bbls.

The hull is arranged with a fore peak, a buoyancy space, five pairs of cargo tanks with a continuous centerline bulkhead, and, as indicated in the illustrations of the vessel, the machinery is concentrated way aft with the engineer's quarters right above the engine room. Aft of the engine room is the cross bunker for the boiler fuel, while forward of the engine space is first the cross bunker for the Diesel engine fuel, and then the coffer dam which separates this from the cargo tanks.

There is a raised forecastle deck over the fore peak and buoyancy space which provides the quarters for the deck crew beneath it. The raised quarter deck aft provides the quarters for the steward's crew, the galley, and the mess room in addition to the engineer's quarters. All of these rooms are arranged around the machinery trunk over the central portion of the engine room. The forecastle deck and the quarter deck are connected by a catwalk for use in bad weather at sea.

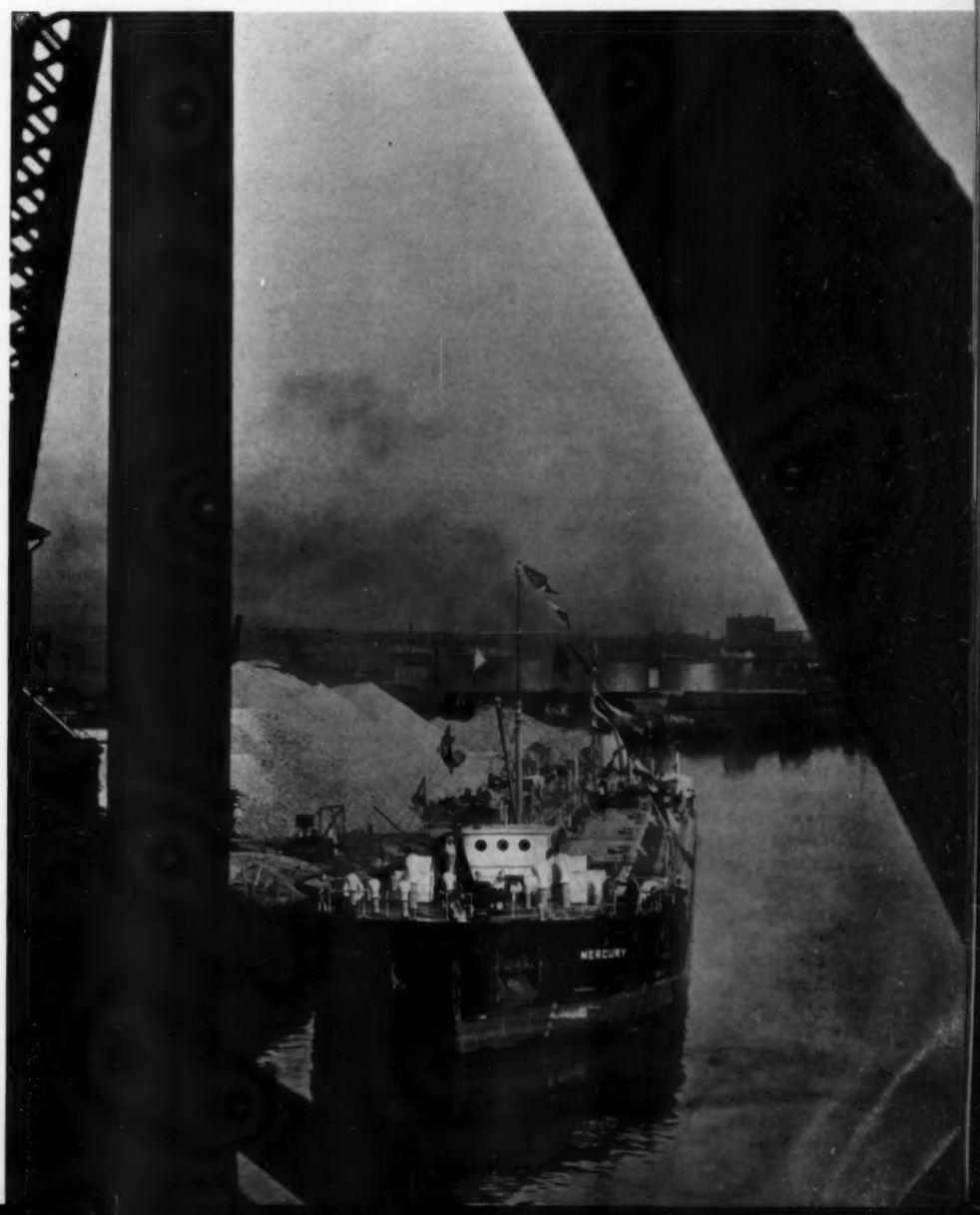
The most important items in the engine room are the twin screw propulsion engines. These Winton Diesels are of the four cycle, solid injection common rail type. Made directly reversible, they have six cylinders, 14″ bore by 16″ stroke, and are rated at 465 hp. at 300 rpm. each. They give the vessel a fully loaded speed of about 9.5 knots.

These engines are of standard Winton design of their type and in order to make them self-contained and avoid operation of additional machinery as far as possible, they have all necessary engine pumps attached to the engines at the forward end. The control station is on the inboard side near the after end, with the engineer's desk and the Bendix engine room telegraphs adjacent and between the two engines.

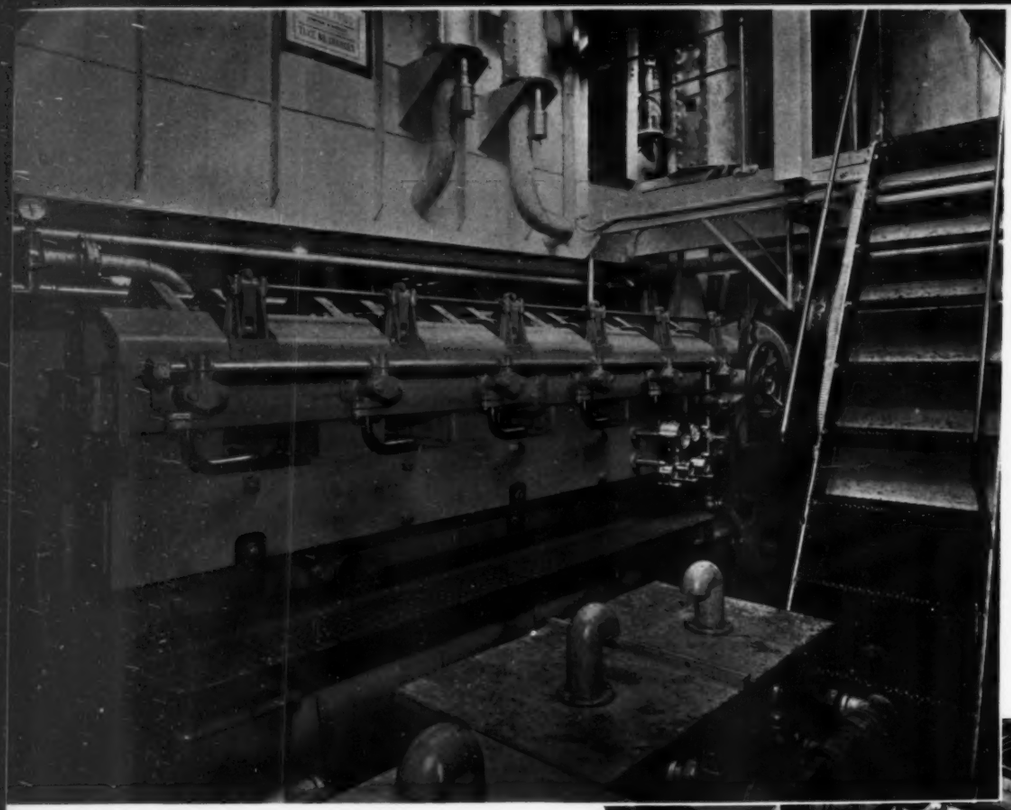
This idea of reducing the amount of machinery in operation to a minimum at all times has been carried right through the layout of all of the auxiliary equipment as will be developed as the various items are mentioned.

The main engines are connected to Erie Forge propeller shafts, from which are taken the drive for the 10 kw. Electro Dynamic 120 volt generator which supplies electric power while at sea. There is a clutch in this drive for disconnecting the generator when desired. The Columbian Bronze propellers are of Stephen E. Slocum (Aerofoil) design, 6′ 4″ diameter and variable pitch. The effective pitch at 25½″ radius is 3.8′.

The air for the main engines is taken from



The Diesel tanker "Mercury" as viewed through the girders of a steel bridge near her loading station.



One of the six-cylinder 465 hp. Winton Diesels which drive the "Mercury" fully loaded at 9.5 knots.

the engine room, while the exhaust passes through a three way valve which can send the gases through the Maxim silencers in the engine trunks or through the Davis Engineering donkey boiler. The gases leaving either the silencers or the boiler pass through the tail pipes up the stack. This donkey boiler is 93″ diameter and 17′ high, and is equipped with an oil burner for use when exhaust gases are not available. For use in connection with this boiler, there is an Elgin water softener outfit complete with filter tank, deconcentrator, feeders and test set. And there are a Davis Paracoil feed water heater, a Paracoil condenser, two Paracoil swing valves, a Davis Butterworth heater, and a Paracoil fuel heater.

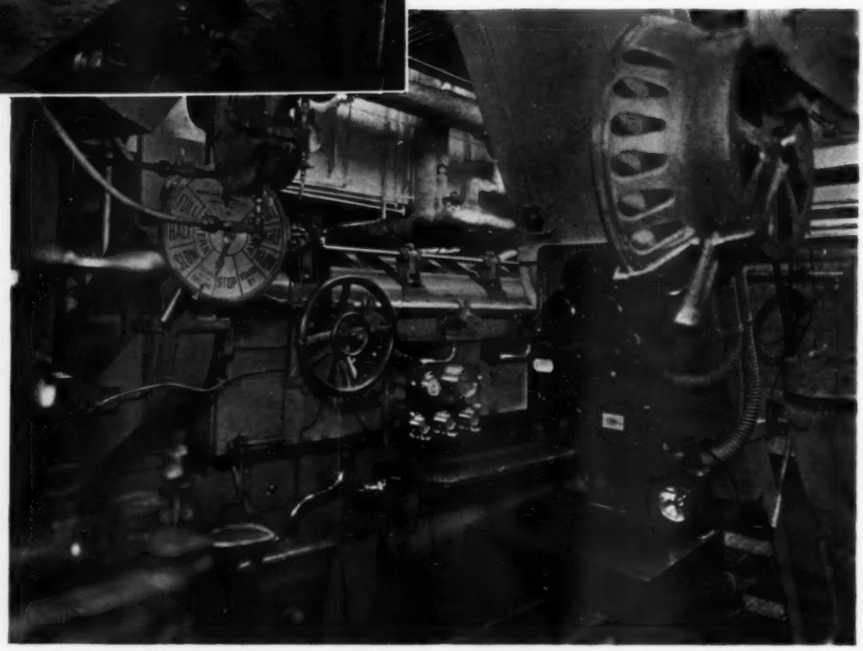
Fuel oil for these engines flows from the bunker through a Cuno coarse mesh strainer and a Sentinel fuel filter to ensure clean fuel. From the bunker, fuel is delivered to the two day tanks placed well up on the engine room bulkhead, where they can supply the fuel injection pumps by gravity.

Each engine has a low pressure transfer pump in addition to the high pressure injection pumps. And there is a Northern fuel pump driven by a 1½ hp. Electro-Dynamic motor, and also a hand pump.

The engines are pressure lubricated with the pumps attached to the engines. There are oil coolers for tempering the temperature of the oil, and Sentinel lubricating oil filters are used to keep it clean.

and also in a 5 kw. Terry steam turbine generator set for auxiliary use. The ship's pumps and machinery are partly steam driven and partly electric motor driven in order to obtain the greatest flexibility in operation. For instance, the steering gear is of the American Engineering hydro-electric type. There is a steam whistle, and also an air operated signal. The compressed air for the latter is taken from the starting air tanks through a reducing valve. The deck machinery is steam operated. The boiler pumps are partly steam and partly motor driven; in fact, both types of boiler feed pumps are provided.

For supplying electric power when in port, there is a 15 kw. auxiliary generator driven by a two cylinder 25 hp. Winton Diesel engine with four cycle cylinders of 5″ bore and 7″ stroke. At the end of the engine opposite the generator, the crankshaft is extended for driving the auxiliary air compressor, already mentioned, through a clutch. Again, this engine unit is self-contained with its own service pumps.



Operating side of the other Diesel with the Brown pyrometer and alarm bells in the foreground.

Salt water is circulated through the jackets for cooling purposes by plunger pumps attached at the forward end and driven from the engines. The discharge is overboard, but enough water is recirculated to maintain the proper temperatures.

Starting air is usually supplied by the Gardner-Denver two stage machine driven by one of the cargo pump Diesels, but there is also an auxiliary compressor driven by the auxiliary generator Diesel engine.

The steam generated in the donkey boiler from the main engine exhaust at sea is used for heating the vessel's living quarters in cold weather,

There is also a 100 cell Edison lighting battery rated at 150 ampere capacity. All of the electrical circuit controls are concentrated at the Smith Meeker switchboard.

All of this auxiliary equipment is located in the wings of the engine room space outboard of the main propelling engines.

But there are two more Diesels. Of the same cylinder size as the auxiliary engine (this sim-

plifies the spare part and maintenance problem), these other two Winton Diesels are used primarily for driving the ship's cargo pumps. The pumps themselves are located at the sides in the coffer dam space forward of the engine room and beyond the ends of the Diesel fuel cross bunker between them. Thus the engines for driving the pumps are located in the extreme wings of the space at the forward end. The cargo pumps are of the rotary type, of Northern design and manufacture, and each is rated at 1,200 gallons per minute at 100 lb. per sq. in. pressure. The shafts for driving the pumps extend through the bulkhead with stuffing boxes on them.

These cargo pump Diesels are six cylinder engines rated at 100 hp. at 1,000 rpm. The crankshaft of one of them is extended at the opposite end from the pump to take a clutch for driving the main air compressor already mentioned.

All of these auxiliary Diesels take their intake air from the engine room, and the exhaust is through the Maxim silencers in the engine trunk with tail pipes up the stack. Each engine has its own fuel, lubricating oil, and cooling water system so that it is an independent operating unit. These systems are all similar to those for the main engines already described. But the starting of these smaller engines is by electric motor acting through a gear on the flywheel rim in the regular way. Each engine has its own charging generator attached to the engine and its own starting storage battery.

There is a 2" two stage centrifugal type fire pump driven by a converted Ford V8 gasoline engine. The fuel tank for this engine is placed outside on the deck. There are connections from this pump to the circulating water systems of the Diesel engines for emergency use in cooling should the Diesels' own pumps fail.

Stern view from water level of the "Mercury" under way.

Ship's sanitary pumps are electric motor driven, and Andale duplex strainers are used on the sea water suctions. Electric power was chosen for these because it is always available when they are needed and the pump units are small in size.

The completeness, the flexibility of operation, and the overall operating economy of this installation are obvious. The primary source of power is the Diesel engine, whether it be for propelling the vessel, pumping the cargo, or generating electricity for miscellaneous use. When the ship is at sea, the electric power is obtained from the most economical source — the main engines. And if the shaft driven generator is out of commission, there is power available from the steam turbine unit. This power and any steam needed to heat the ship are obtained without added cost of operation.

There is no real duplication of machinery. These tankers are worked intensively and dependability of operation is of paramount importance. The setup of equipment provided permits the engineers to not only meet all of the vessel's requirements but to do so in the most economical manner, considering the operating conditions at the moment, and with a minimum amount of machinery in operation. All five Diesels have their own individual roles to play in the performance, and they are important ones.

This description of the latest Diesel tanker recalls to mind the two new Diesel freighters, *Green Island* and *Norfolk*, recently delivered to the Ford Motor Company and described in the August issue of DIESEL PROGRESS. In designing and building all three of these vessels the maximum saving in weight and cargo space has been effected by the combination of Diesel engines for propulsion and welded rather than riveted hull plating. Such a combination gives the owners the maximum and most economical carrying capacity per dollar of investment.

General deck arrangement. The fore and aft calt walk stands prominently in the center.

In 16 years SHAVER, of has Bought 16 New

THE "WAMPUS MARU"
42' in length, 9' beam, 4' draft. Powered by a 3-cylinder 7½" x10½", 50 hp. reverse gear Atlas Imperial Marine Diesel with pilot house control.

CAPTAIN LEONARD SHAVER
Vice-President and dispatcher

CAPTAIN HOMER SHAVER
General Manager

CAPTAIN GEO
Secretary

THE "TREVE E"
56' in length, 14' beam, 5½' draft. Powered by a 6-cylinder 9" x 12", 160 hp. Atlas Diesel with pilot house control.

THE "SHAVER"
130.9' in length, 30.8' beam and 6.7' draft. Formerly a stern wheel s type tow boat in 1926 and powered by a pair of 6-cylinder, 1[illegible]" x 18" 4 rine Diesels. The "Shaver" also carries a 50 hp. Atlas Imperial Dies

THE "CRUISER"
70' in length, 16' beam, 6.1' draft. Powered by a 6-cylinder 12½" x 16", 350 hp. Atlas Imperial Diesel with pilot house control.

THE "ECHO"
58.2' in length, 12.3' beam, 3.5' draft. Powered by a 4-cylinder, 8½" x 12", 90 hp. Atlas Imperial Diesel.

THE "SMITHY"
2.7' in length, 19.8' beam, and .1' draft. Powered by a 6-cylinder 14" x 18" 400 hp. Atlas Imperial Marine Diesel with pilot house control.

THE "PEARL"
84' in length, 15.5' beam and 5' draft. Powered by a 6-cylinder, 9½" x 13", 200 hp. Atlas Imperial Marine Diesel.

THE Shaver Transportation Company of Portland, largest towboat company on the mighty Columbia River, stands as a monument to George W. Shaver, an early pioneer who crossed the plains into Oregon in 1854. He founded the Peoples Freighting Company, whose steam stern wheelers are interwoven with the early history of Oregon and Washington.

George W. Shaver had four sons who were brought up in the business, Captains James, George, Delmer and Lincoln. In 1893 they incorporated as the Shaver Transportation Company. Like any other business that was literally carved out of the wilderness, the towing business of the Shavers had its ups and downs, but throughout the years it has enjoyed a reputation for dependability of service and stability of management, and each year has registered healthy and substantial growth.

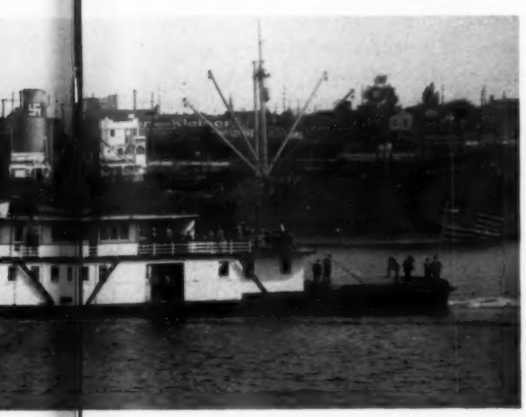
Today, the responsibilities of the business rest upon

ATLAS IMPERIAL DIESE
OAKLAND, CALIFORNIA

ATLAS IM

R, of Portland, ew ATLAS DIESELS!

SHAVER (CAPTAIN GEORGE M. SHAVER) CAPTAIN DELMER SHAVER
ger *Secretary-Treasurer* *President*



THE "SHAVER"
merly a stern wheel steamer, converted to a twin screw tunnel -cylinder, 11½" x 18" 400 hp. Direct Reversible Atlas Imperial Ma- . Atlas Imperial Diesel Auxiliary.

upon the third generation, Captain Homer Shaver as General Manager and Captain Leonard Shaver as Vice-President and dispatcher of crews and equipment. Captains George and Delmer, shown above, now serve the younger men in an advisory capacity. Their principal business is in towing log rafts on the Columbia and Willamette Rivers, interspersed with the movements of barges and ships.

The growth and financial success of the Shaver operations is attributable to the ability of the Shavers to obtain new business and hold old customers, their choice of operating personnel, and their astute judgment in the selection of equipment. At the propitious moment they discarded steam in favor of Diesel, and when they decided upon a Diesel they chose a good horse and have stayed in the saddle. They started with a 90 hp. Atlas Diesel in 1921, and in 1937 installed their sixteenth Atlas, a 480 hp. engine, giving them a total of 3500 hp. in Atlas Imperial Marine Diesels.

L DIESEL ENGINE CO.
MATTOON, ILLINOIS

MPERIAL

THE "JAMES W."
90' in length, 20' beam and 5.5' draft. Powered by a 6-cylinder, 11½" x 15", 275 hp. Atlas Imperial Marine Diesel.

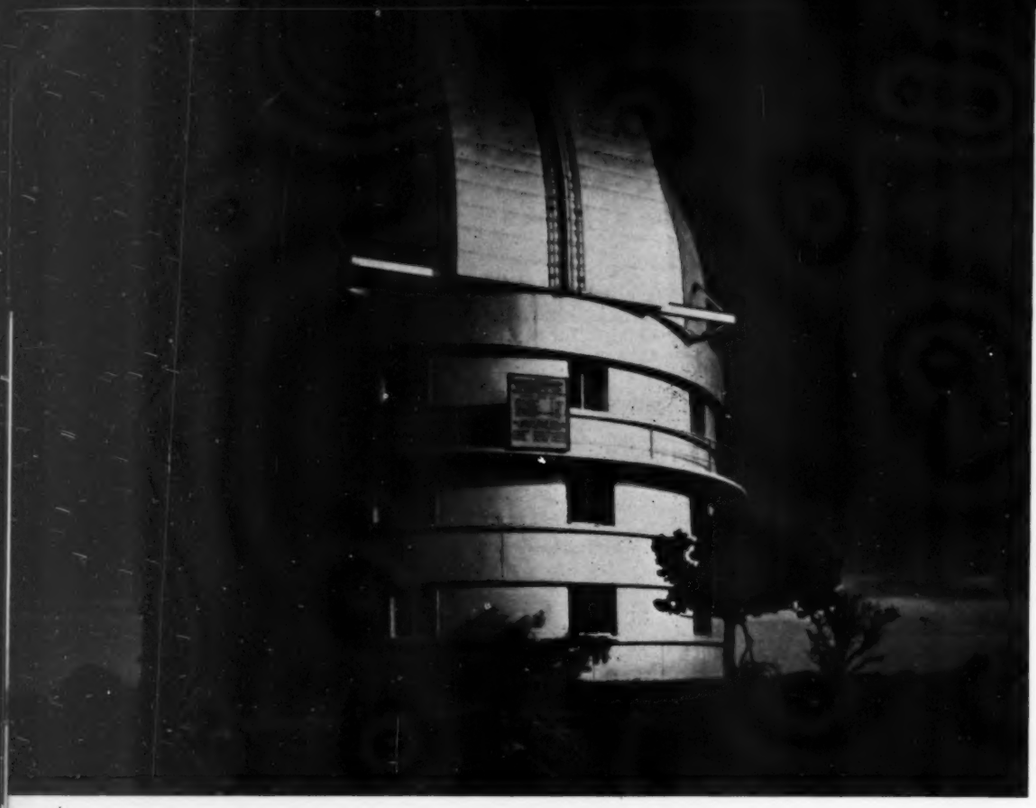
THE "KENWOOD"
52' in length, 13' beam and 4' draft. A semi-tunnel type tow boat, powered by a 6-cylinder, 8½" x 12", 140 hp. Atlas Imperial Marine Diesel.

THE "CHARM"
75' in length, 11' beam and 4.5' draft. Powered by a 4-cylinder, 8½" x 12", 90 hp. Atlas Imperial Marine Diesel.

THE "WILAVIS"
58.7' in length, 16.1' beam and 8' draft. Powered by a 6-cylinder, 11" x 15", 250 hp. Atlas Imperial Marine Diesel.

Below—
The "GEORGE W."
93' 3" in length, 20' beam and 9' draft. Powered by a 6-cylinder, 14½" x 18", 480 hp. Atlas Imperial Marine Diesel. She also carries a 4-cylinder, 4¾" x 6½", Atlas Imperial Auxiliary.

THE "OLIN W." (*Above*)
47.3' in length, 14.11' beam and 3.8' draft. Powered by a 4-cylinder, 9" x 12", 110 hp. Atlas Imperial Marine Diesel.



SEEING S

Two Winton Diesels Supply Power to the McDonald Observatory Atop Mount Locke.

By JOHN W. ANDERSON

IN 1926 Mr. W. J. McDonald of Paris, Texas, bequeathed a fund for erecting and equipping an astronomical observatory to be used in connection with and as a part of the University of Texas. The location of the McDonald Observatory in the Davis Mountains, West Texas, is remote, there being no electric power, natural gas, or water supply within 16 miles of the site. It is 420 miles west of San Antonio, 200 miles east of El Paso, 43 miles from the nearest railway, and 16 miles from the historic Fort Davis, the nearest settlement. A scenic highway leads from Fort Davis to the Observatory.

The observatory dome was built atop Mt. Locke, 6,900 feet above sea level. This location was selected because of the unusually clear atmospheric conditions. The average annual visibility (about 80 per cent) is considered as good as or better than any other observatory site in the United States.

In the observatory structure, the lower two floors will provide office space, library, dark rooms, some control equipment, and limited living quarters for some of the junior members of the observatory staff. The upper or third floor is called the observing deck, and is 63 feet in diameter. The observing bridge can be moved electrically in six different directions; up or down, right or left, forward or backward. Two third floor observing platforms mounted on hydraulic hoists may be elevated to any position up to 15 feet above the floor level.

In the dome is the telescope, the second largest in the world, with an 82 inch diameter mirror. The instrument is 26 feet long with five secondary mirrors along the framework, so mounted that the light of any star can be concentrated and viewed with the aid of prisms, photometers, and other analyzers. This telescope will be used to study primarily the relatively new field of astrophysics, which treats of physical and chemical characteristics of heavenly bodies.

The utmost precision is necessary in the building and the operation of an instrument so heavy and yet so delicate. It can be operated electrically by one individual who by touching buttons can raise or lower the platform (on which he is standing) along the telescope, revolve the 140 ton 63 ft. diameter dome, open the shutter to a 15 ft. slit in the dome to give the telescope access to the heavens, or raise curtains to protect it from the winds. Automatic electric timing turns the telescope slowly from east to west to follow the paths of the stars under observation.

The nearest electric power service to the observatory is about 16 miles away. Uncertainty of voltage control and possibility of interrupted service with an outside source of power, made it necessary that the electricity for the operation of the telescope and accessories, as well as the supply for dwellings and the other auxiliary buildings, be generated near the observatory.

Absolute continuity of power at the observatory dome (maximum demand of about 20 kw.) is necessary, because the failure to obtain data on a star at some predicted time might be distressing to the observers, especially if the star were visible only from this observatory and after months of waiting. Hence, even though outside power were available, standby units would be necessary to assure electric service at all times.

Due to the continuity of service and close regulation required, first thought would have indicated the use of steam turbine or engine driven generators, instead of Diesel power. However, the lack of sufficient water, the distance from railroad facilities to obtain fuel, and other considerations obviated the use of steam generating equipment. Upon investigation of the regulation possible with present day Diesel engines, it was found that with the use of Woodward governors, direct current generators and voltage regulators, Diesel engines would be most suitable for the power installation. The use of Diesel generating units was at first considered undesirable because of possible engine vibration affecting the precision of the astronomical observations, noisy and smoky exhaust, probable engine starting difficulties, and the likelihood of not to be able to obtain a voltage regulation of 1 per cent, plus or minus, as required by the extreme accuracy of the automatic electric

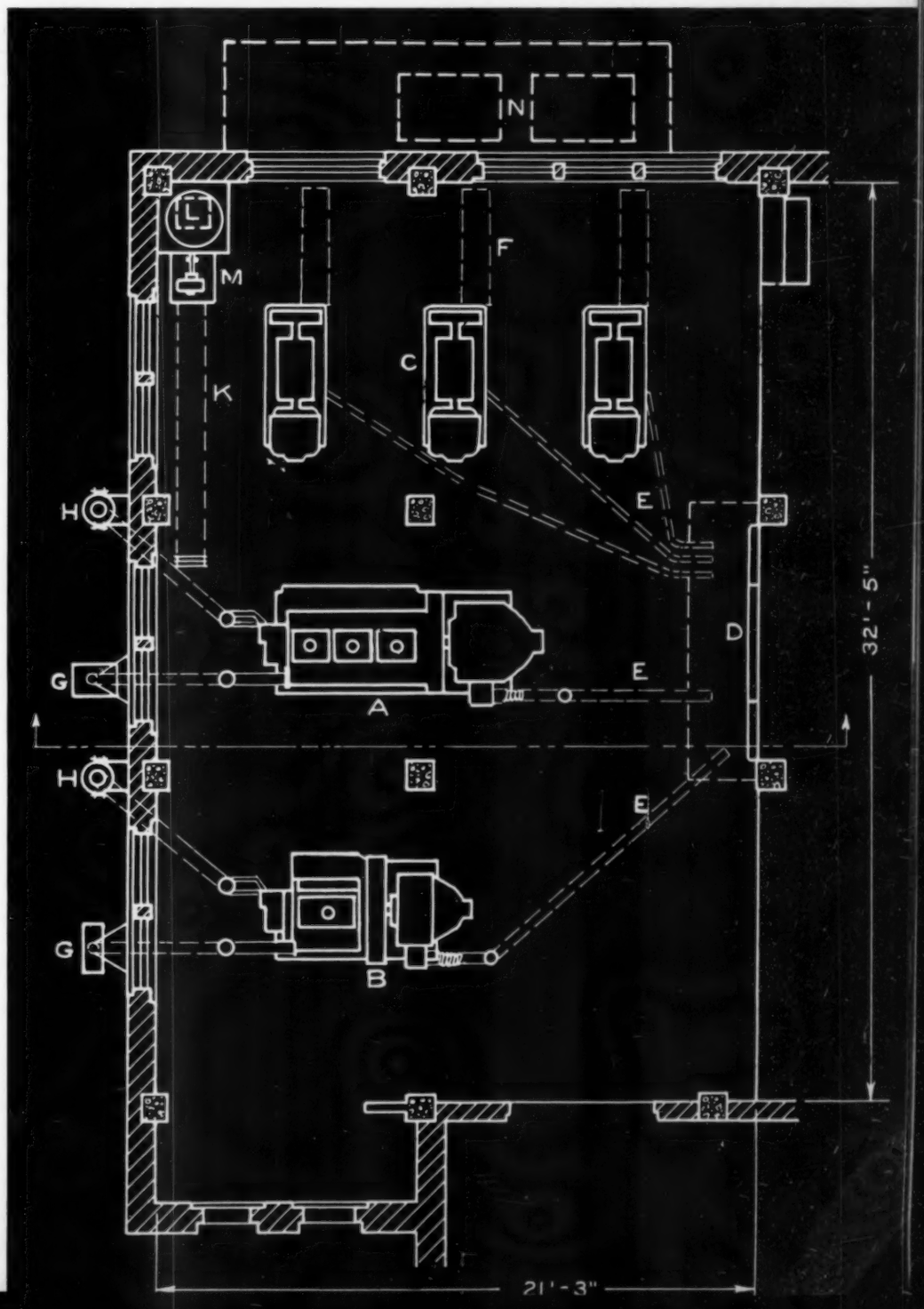
STARS WITH DIESELS

operation of the telescope dome, and interrelated observatory instruments and auxiliaries. The overcoming of these difficulties meant careful selection and installation of the generating equipment.

The builders of the telescope considered it necessary that the precision of their mechanism and the accuracy of observations be within 1 per cent, plus or minus, and thought it advisable to use direct current power, which is more easily regulated than alternating current power. The problem of maintaining this close regulation and parallel operation of several generators, despite the application of varied electrical loads from one light bulb to a 7 hp. elevator motor, made it necessary to use Woodward governors on the Diesel engines, compound wound generators, specially built voltage regulators, and other electrical controls to insure extreme accuracy for all related observatory work.

After some calculations of the possible near future electrical load of the entire observatory project, it was predicted that the maximum requirements would be about 45 kw. Accordingly, two Winton Diesel generator units, one 50 kw. and one 25 kw., were purchased and installed in the power plant building, which is located about 250 feet away from the observatory.

The power plant building is a two story structure on the hillside. The ground or basement floor is occupied by the power plant and the machine shop, while the second floor on the same level as the roadway is the storage garage. The two Diesel generating units are alongside of each other in between the columns which support the garage floor above. With the ends of the engines next to the outside wall, the exhaust pipe connections to outside are simple. On the other end of the units are the generators with the switchboard beyond. At one end of the engine room are three gasoline engine generating units. Two are 10 kw. in size, and one of 5 kw. They are intended to supply the power when the load is less than 10 kw. which will be the case during the greater part of the daylight hours. These units are so interconnected, however, that they can supply the power for the observatory dome when close regulation is not required. They also serve as emergency standby units, that can be started by hand cranking, for furnishing emergency power and for recharging the storage battery which furnishes the energy for starting the Diesel units.



Legend

A. Six-cylinder, four-cycle Diesel engine direct connected to 50 kw. 600 rpm. generator
B. Three-cylinder, four-cycle Diesel engine direct connected to 25 kw. 600 rpm. generator
C. Gasoline engine driven generator units
D. Switchboard
E. Electrical cable conduits
F. Gasoline engine exhaust silencers
G. Diesel engine air intake filter
H. Diesel engine exhaust silencer
I. Cooling tower
J. Radiators
K. Heat exchanger
L. Cooling water expansion tank
M. Motor driven raw water circulating pump
N. Fuel oil day tanks
O. Engine foundation block

Two four-cycle Winton Diesels were chosen and they are of the same cylinder size, 6½" by 8½", with three cylinders for one unit and six for the other. This gives the advantage of interchangeability of spare parts. The two engines are rated at about 50 and 100 hp. respectively at 600 rpm. at sea level, but at the elevation of the observatory, 6,900 feet, they are rated at 25 and 50 kw. respectively. Of standard design with common rail system of solid fuel injection and fitted with Woodward governors, engines are direct connected to the generators. Necessary auxiliaries are attached to the engines.

The generators are of the compound wound commutating pole type and are mounted on the same sub-base with the Diesel engines. Current is generated at 125 volts, and each generator is provided with a direct acting voltage regulator mounted on the switchboard. The voltage regulator maintains the rated voltage within 1 per cent, plus or minus, for any load from zero to 25 per cent overload regardless of load variations. During parallel operation the 25 kw. generator automatically takes one third of the load and the 50 kw. generator takes two thirds of the load imposed upon the electric system.

Special precautions were taken against the transmission of vibration. The heavy concrete foundation blocks rest on the cork insulation under them. The generating units are mounted on Korfund vibration dampeners secured to the top of the foundation blocks. Intake, exhaust, and cooling water pipes have flexible connections adjacent to the engine to prevent transmission of vibrations through the piping connections. The conduit for the electrical cables from the generator to the switchboard also has a flexible connection adjacent to the generator.

Exhaust from the Diesels leads in separate pipes from the engine headers down under the floor, out through the wall, and into the Maxim silencers extending vertically upward. Supporting foundations for these silencers are built underneath, alongside of the building wall. These Maxim units are of ample capacity to eliminate effectively all noise from this source. The tail pipes extend up above the building roof line to carry the gases well clear. The exhaust from each gasoline engine leads from the engine up to its own silencer suspended from the ceiling overhead, and the tail pipe leads out horizontally through the end wall.

The fuel system starts with the two storage tanks of 1,500 gallons capacity each. They are of sufficient capacity to provide for about six months' operation. Located below the level of the roadway outside, they are conveniently filled from tank trucks, yet they are above the engine room floor level. Fuel flows from them by gravity, through the strainer, to the motor driven transfer pump; then is pumped through the meters to the individual engine 100-gallon day tanks, or it can be by-passed back to the storage tanks. The latter connection permits of transferring fuel from one storage tank to the other. Tanks can be emptied through the drain valve. From the day tank, the fuel flows by gravity to the engine pumps, and the overflow or surplus returns to the top of the day tank. The system includes suitable valves, vents, and filler pipes.

Each engine has its own self-contained lubricating system, with pressure pump, filter, cooler, pressure gauge, thermometers, and low pressure alarm. The lower part of the bedplate serves as the sump.

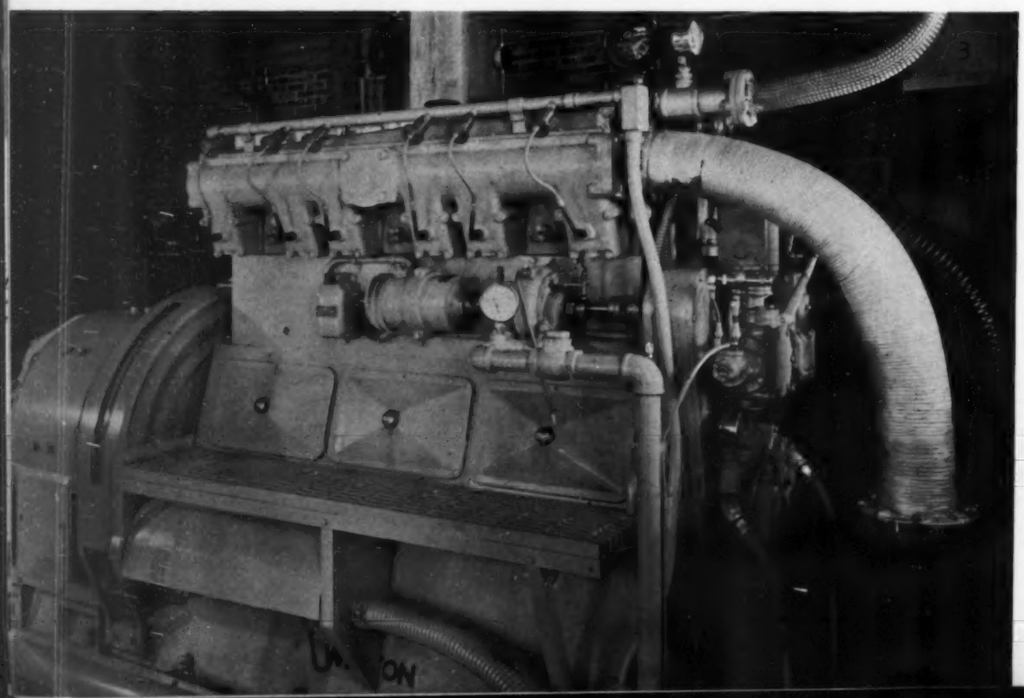
Only a limited quantity of good water suitable for cooling the engines was available from wells at the observatory site, so it was necessary to choose a cooling system that would be economical in its use of this water. A closed system was selected.

Taking the soft water circuit first, there is the 144-gallon range boiler used as an expansion tank and located in one corner of the engine room. The heat exchanger is below it. Each engine has its own attached circulating pump. The water flow is from the expansion tank, down through the heat exchanger, to the large header from which suction connections are taken to the individual engines. The makeup feed for this circuit is added to this header. On the engine, it flows through the oil cooler to the circulating pump, thence through the jackets, and overflows back to the top of the expansion tank. Each engine has a pump for circulating the water through it after the engine is shut down in order to thoroughly cool it. There are thermometers on the inlet and outlet from each engine.

The raw water is circulated by the 50-gallon per minute motor driven pump. The flow is first through the heat exchanger, then to the radiators and the cooling towers, and back to the pump. The radiators are in series with the cooling towers, and there is a by-pass for the radiators. The cooling towers are on the level of the garage floor, while the radiators are on the deck above that floor. When the engine jacket water heat is wanted for heating the garage, the raw water is sent through the radiators; but as less heat is needed, more of the water is by-passed through the cooling towers. The radiators are fitted with automatic control switches which start the motor driven fans back of them when the water in the radiators reaches 180 degrees, and stops the fans when it cools down to 120 degrees.

A full set of instruments has been fitted. In addition to the usual pressure gauges and thermometers, there are the low lubricating oil pressure alarm (already mentioned) and the high temperature engine jacket water alarm. There is an Alnor exhaust pyrometer, with connections to every cylinder on both engines.

Before leaving the factory and again after installation, these units were subjected to very rigid tests to make sure that they would fulfill the unusually severe operating requirements. Results of tests conducted at the observatory are given in the tabulations, and it must be remembered that these tests were conducted at 6,900 feet above sea level.



TEST OF 6-CYLINDER 50-KW. WINTON DIESEL ENGINE McDONALD OBSERVATORY, ELEVATION 6900 Ft. AUGUST 14-15, 1936

Per cent of full load	10%	26%	50%	78%	100%	125%
Fuel oil pressure, lb.	2000	2400	3200	4200	4400	5000
Lub. oil pressure, lb	20	20	20	20	20	20
Water temp. in, deg. F.	131	128	125	142	130	135
" " out, deg. F.	137	137	135	152	145	150
Lub. oil temp. in, deg. F.	130	135	130	143	134	140
" " " out, deg. F.	145	142	140	148	145	150
Exhaust temp. cyl. No. 1	340	400	390	550	660	760
" " " " 2	330	360	420	530	650	755
" " " " 3	330	360	500	520	645	760
" " " " 4	320	370	400	540	680	800
" " " " 5	315	370	450	530	680	800
" " " " 6	360	390	540	540	680	790
Ave. temp. for 6 cyl.	330	375	450	535	665	780
Revolutions per minute	600	600	600	600	600	600
Fuel per hour, lb.	13	16.8	22.4	28	34.4	45.7
Volts, D.C.	125	125	125	125	125	125
Amperes, D.C.	40	104	202.5	312	404	480
Kilowatts delivered	5	13	25.3	39	50.5	60
Generator eff., per cent	?	86.5	86.5	87.8	87.8	87.6
Brake hp. of engine	?	20.2	39.2	59.6	77.1	92
Lb. fuel per kw. per hr.	2.6	1.29	0.886	0.718	0.681	0.761
Lb. fuel per bhp. per hr.	?	0.832	0.572	0.47	0.446	0.496
Fuel cost of 1 kwh. with oil at 8c per gallon	$ 0.03	0.015	0.0103	0.0083	0.0079	0.0088
Fuel cost to operate engine 1 hr. with oil at 8c per gal.	$ 0.151	0.195	0.26	0.325	0.40	0.53

Fuel

Gas Oil purchased from Conoco Corporation.

API gravity at 60 F. = 37.9. API gravity at 80 F. = 39.4.

Specific gravity at 60 F. = 0.8355. Specific gravity at 80 F. = 0.8280.

Density at 60 F. = 6.956 lb. per gal. Density at 80 F. = 6.894 lb. per gal.

Type of Engine

Winton Model 6-179; four-cycle, single-acting, vertical, valve-in-head, six cylinders, 6½" x 8½", electric starting, solid-injection (common rail) fuel system.

Class of Service

Stationary, mounted on Korfund vibration dampers and cork isolated foundation; engine direct-connected to a G.E. Direct Current 125-volt generator rated 50-kw. at 600 rpm. at 6900-ft. altitude. Connected in parallel with a similar 25-kw. engine generator unit.

TEST OF 3-CYLINDER 25-KW. WINTON DIESEL ENGINE McDONALD OBSERVATORY, ELEVATION 6900 Ft. AUGUST 17-18, 1936

Per cent of full load	13%	35%	50%	80%	100%
Fuel oil pressure, lb.	4000	4800	5000	5800	6000
Lub. oil pressure, lb.	20	20	21	20	20
Water temp. in, deg. F.	115	115	125	125	115
" " out, deg. F.	125	125	135	135	145
Lub. oil temp. in, deg. F.	113	115	130	130	125
" " " out, deg. F.	124	128	140	140	140
Exhaust temp., cyl. No. 1	380	450	460	600	720
" " " " 2	330	395	450	540	685
" " " " 3	340	395	445	530	660
Ave. temp. for 3 cyl.	350	410	450	555	690
Revolutions per minute	600	600	600	600	600
Fuel per hour, lb.	8.84	11.07	12.57	16.15	20.3
Volts, D.C.	125	125	125	125	125
Amperes, D.C.	25.6	71.2	104	161	210
Kilowatts delivered	3.2	8.9	13	20.1	26.3
Generator eff., per cent	?	84.5	85	86.25	86.4
Brake hp. of engine	?	14.12	20.5	31.3	40.8
Lb. fuel per kw. per hr.	2.76	1.24	0.974	0.803	0.772
Lb. fuel per bhp. per hr.	?	0.783	0.613	0.516	0.497
Fuel cost of 1 kwh. with oil at 8c per gal.	$ 0.032	0.0144	0.0113	0.0093	0.0089
Fuel cost to operate engine 1 hr. with oil at 8c per gallon	$ 0.1025	0.128	0.147	0.187	0.234

Fuel

Gas Oil purchased from Conoco Corporation.

API gravity at 60 F. = 37.9. API gravity at 80 F. = 39.4.

Specific gravity at 60 F. = 0.8355. Specific gravity at 80 F. = 0.8280.

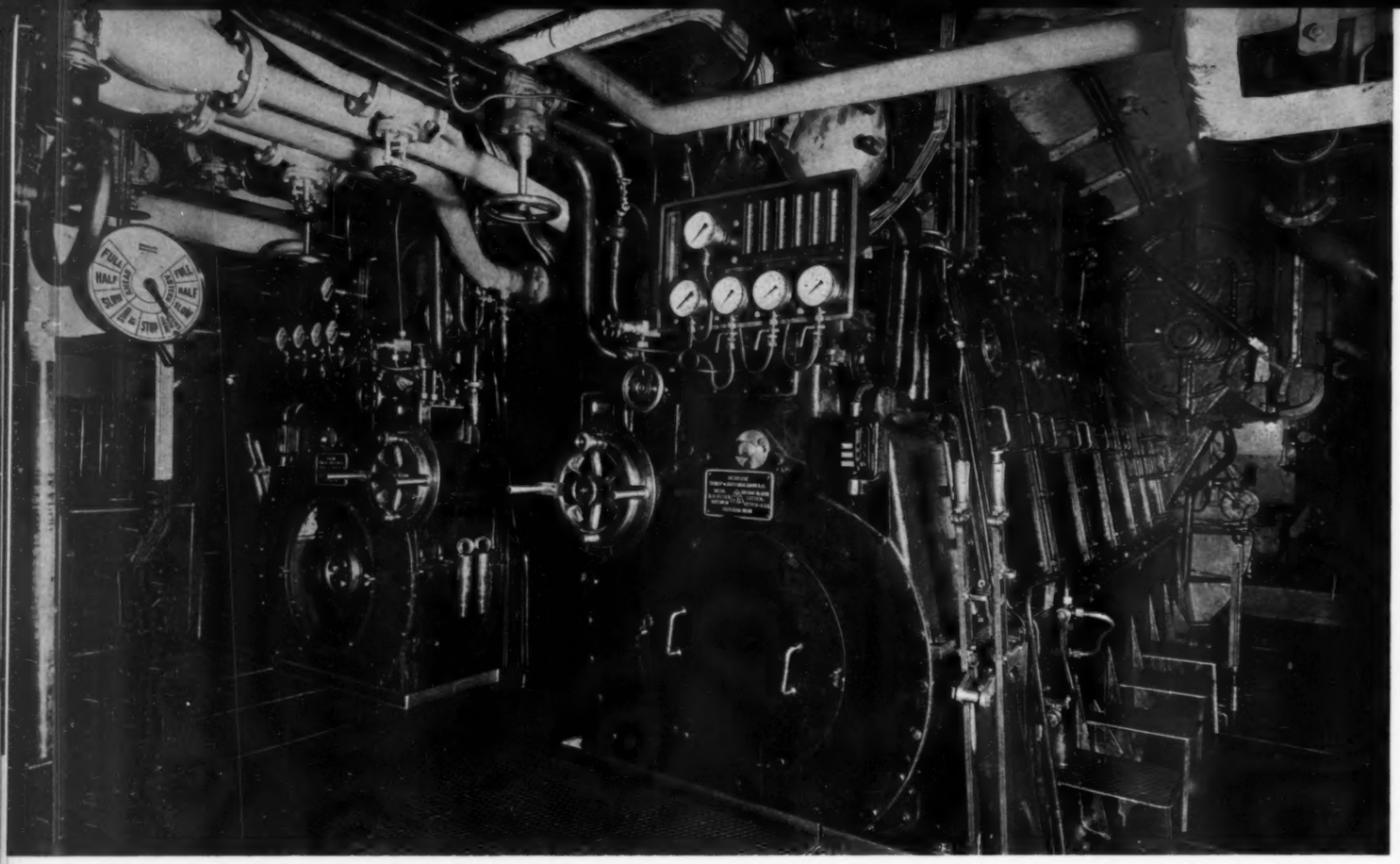
Density at 60 F. = 6.956 lb. per gal. Density at 80 F. = 6.894 lb. per gal.

Type of Engine

Winton Model 3-179; four-cycle, single acting, vertical, valve-in-head, three cylinders, 6½" x 8½", electric starting, solid-injection (common rail) fuel system.

Class of Service

Stationary, mounted on Korfund vibration dampers and cork isolated foundation; engine direct-connected to a G.E. Direct Current 125-volt generator rated 25-kw. at 600 rpm. at 6900-ft. altitude. Connected in parallel with a similar 50-kw. engine-generator unit.



Lower engine room view of the new geared motorship, "Gambian," showing her two 1,200 hp., six-cylinder, two-cycle M.A.N. Diesels.

LONDON LETTER NO. 22

By G. R. HUTCHINSON*

SINCE the last issue of DIESEL PROGRESS was published some important and particularly interesting marine Diesel installations have been completed. Chief of these in the technical sense are the two geared motorships *Gambian* and *Werna.*

The geared motorship is a line of progress which has not received a very enthusiastic reception in Britain and, so far as the writer is aware, a similar position holds in your own country. In Germany and Holland, on the other hand, several of the leading owners have adopted the geared Diesel drive with success, while a high-powered passenger motorship with geared engines is at present building for Norwegian owners.

The *Gambian* is noteworthy in being a British owned vessel, although both hull and machinery were built in Germany by the Deutsche Schiff- und Maschinenbau A.G. The *Gambian* is a vessel of about 8,000 tons deadweight capacity and approximately 11 knots service speed. and, including the deep tank, has five cargo holds. Her machinery comprises two M.A.N.-type trunk-piston Diesels of the latest two-stroke cycle pattern with in-built scavenging blowers arranged at the side of each engine and driven from the crankshaft by a roller chain. Each engine has six cylinders and is rated at 1,200 bhp. at 275 rpm. Views of the top platform and engine room floor are included with this note and the interesting lay-out of the machinery will be observed. Transmission is through large-diameter Vulcan hydraulic couplings and single-reduction helical gears to a single propeller shaft having a normal speed of 90 rpm. Either of the couplings may be filled with oil from a gravity tank in the engine casing in 40 seconds, while emptying, if necessary, can be accomplished in about 15 seconds.

Electricity for various engine room auxiliaries, deck winches, steering gear, etc., is provided by three 110 kw. Diesel-generator sets having a supply pressure of 225 volts. Each of these generators is driven by a five-cylinder M.A.N. four-stroke engine and in the case of two sets a starting air compressor may be driven through a friction clutch from the end of the generator spindle. By reason of the compact nature of the main machinery the engine room of the *Gambian* is very spacious and the main engines are commendably moderate in weight.

Turning now to the geared motorship *Werna,* this vessel is noteworthy in having the first installation of geared Diesel machinery by the Atlas Diesel Co. of Stockholm, in which the new Asea clutch is incorporated. This is a magnetic type of slip coupling and, in common with the Vulcan hydraulic clutch, there is no mechanical contact between the two coupling halves. The small amount of current used by the couplings is provided by the Diesel-

**Editor of "Gas and Oil Power" and Managing Director of the Whitehall Technical Press, Ltd.*

generator sets which supply current for the various engine room auxiliaries, etc.

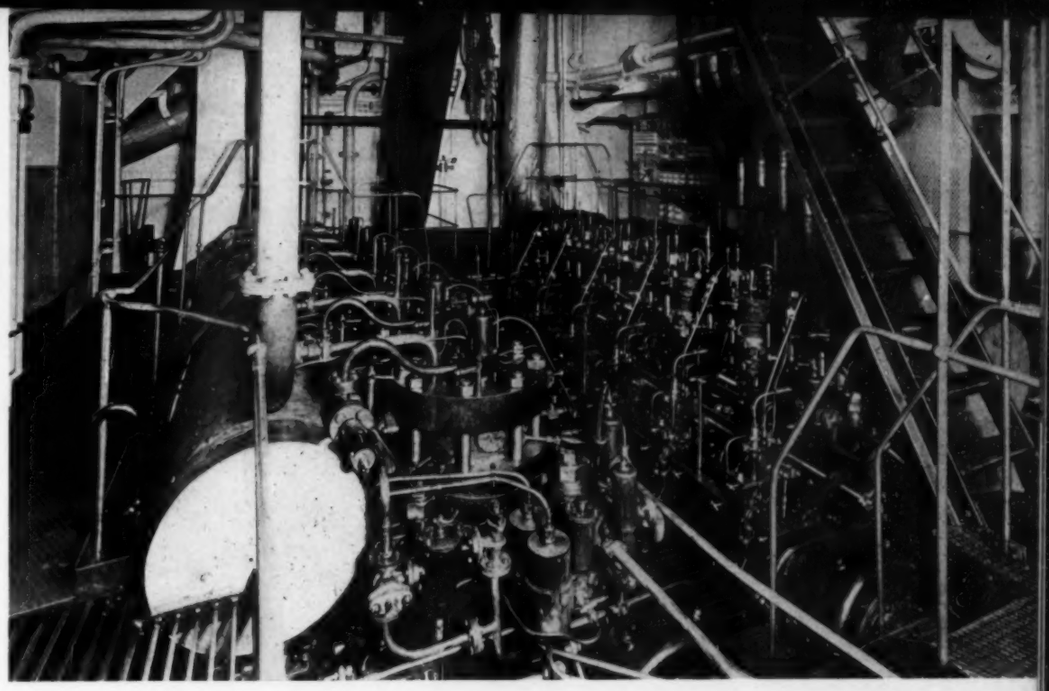
The *Werna* is a small vessel about 230 ft. long and having a deadweight capacity of 120 tons, and her main engines comprise two 700 bhp. at 300 rpm. Polar two-stroke trunk-piston units of a type which has proved very popular in Europe for the propulsion of coastal motorships, tugs, etc. Like the *Gambian's* engines, these units are directly reversible, control of both engines being effeted from the starboard set. It is interesting to note that these engines are not "handed," both being of the left-hand type.

The performance of the *Werna* will be watched with considerable interest because several orders for installations using this electro-magnetic coupling have been placed and the installations are in a fairly advanced stage of construction. This is a distinct compliment to the designers of the coupling, although it has been thoroughly tested out in an experimental installation of geared Diesels in the works of the Atlas Diesel Co. at Stockholm.

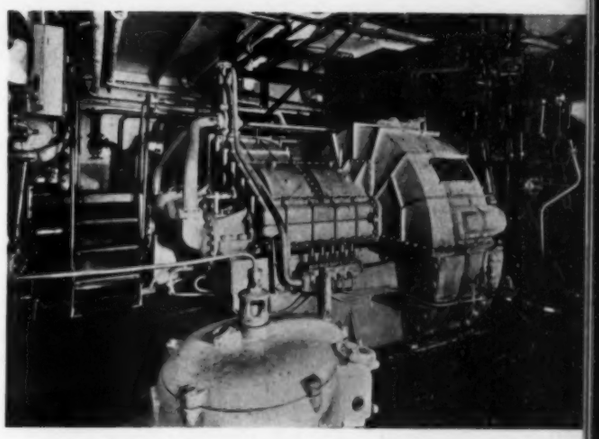
Some months ago a really important order for Drewry-type Diesel mechanical railcars was placed with the English Electro Co., Ltd., of Preston. This was for new fewer than 99 Diesel-mechanical bogie railcars. These were ordered for service in South America by the Buenos Aires Great Southern and the Buenos Aires Western Railways, while eight cars have since been ordered by the Entre Rios Railway in South America. The 99 cars are for a 5 ft. 6 in. gauge track, whereas the Entre Rios vehicles are to operate on a 4 ft. 8½ in. gauge line. It is interesting to add, moreover, that the Buenos Aires Great Southern Railway has ordered a further 11 vehicles with the same engine and transmission units as their railcars for shunting service. These are 0-4-0 locomotives with jackshaft drive and each weighs about 12 tons.

This important batch of orders is now going through the Preston shops very smoothly and recently the English Electric Co. arranged a well organized visit for their business and press friends to see these and other vehicles in course of manufacture. All these cars and locomotives, incidentally, are provided with Gardner engines, the smallest English Electric high-speed engine being much too large for these cars. Each is propelled by a Gardner engine of 102 bhp. at 1,700 rpm., the drive being taken through a Vulcan-Sinclair fluid coupling and a Wilson pre-selective epicyclic gearbox to the single driving axle of the power bogie. The exhaust gases from the engine are passed through a Cochran waste-heat boiler provided with Kirke patent Sinuflo tubes, the water for the heating radiators thus being obtained very economically. The gearbox gives four speeds, the maximum speed with 39 passengers on board being nearly 50 miles per hour.

It should be explained that all the cars in the 99-vehicle order are not the same, there actually being four types if one includes the special luggage and light goods vehicle, of which 15 examples were ordered. There are 38 railcars with accommodation for 39 second-class passengers and 44 vehicles in which the accommodation is divided into first- and second-class compartments of different seating capacities. In some vehicles there is space for passengers who wish to smoke, while in others no such accommodation is available.



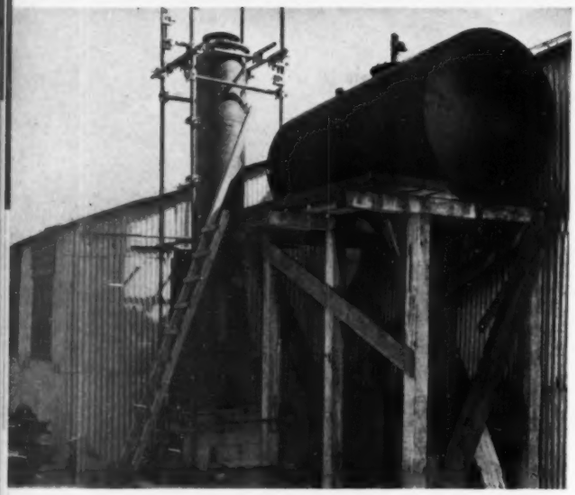
The "Gambian's" upper engine room grating around the cylinder heads. At lower right appear the Vulcan hydraulic couplings and helical reduction gears connecting the Diesels to the propeller shafts.



These cars have a light all-metal body in the frame of which electric welding has been extensively employed, as it is in the construction of the bogies and underframe. We also saw some interesting vehicles for the Ceylon Government under construction, this order comprising three four-coach Diesel-electric trains, each having a six-cylinder 200/220 bhp. English Electric engine having a normal speed of 1,500 rpm. This engine is an entirely new type, but full particulars are not yet available. It is of light yet robust design and this Diesel-electric unit supplies power to two traction motors as well as to various auxiliaries, such as a fan and exhauster. Fuller particulars of these trains will be given later.

Before leaving the subject of railway traction it is interesting to note that the Metropolitan-Vickers Electrical Co., Ltd., of Manchester, in association with the Metropolitan Cammell Carriage & Wagon Co., Ltd., have just completed their first Diesel railcar, which is now in service. This is a double-bogie, single-engined vehicle with seating accommodation for 58 passengers in a one-class saloon. Said to be capable of a speed of 80 miles an hour and to be suitable for hauling a trailer if necessary, it is powered by a single Ganz engine of 240 bhp. at 1,250 rpm. This six-cylinder engine is of the ordinary Ganz type such as has been used in numerous vehicles in the past and was supplied by Ganz & Co. of Budapest. It may be observed, however, that the British interests mentioned have acquired a license to construct engines of this type and future units will be built in this country. In view of the high standing of the firms mentioned there is little doubt that their entry into this expanding field is a matter of real importance.

One of the most novel Diesel plants which I have visited for some time is a Petter installation comprising two similar stations which John Mowlem & Co., Ltd., the well known London contractors, have recently put into operation in connection with some extensions to the Central London Tube in the Mile End-Leyton district of East London. The tube excavations in this area are likely to be rather difficult, so work has been commenced on the middle portion. Air for the workmen is fed from motor-driven rotary compressors arranged in two temporary corrugated iron power houses at either end of the workings. Interior and exterior views of one of these powerhouses accompany this note



One of two Diesel plants erected in connection with extending the Central London Tube. In each, two Petter, two-cycle, 224 hp. Diesels drive blowers to supply air to the workmen below ground. Dependability of this air supply is a matter of life or death.

and these serve to show the ingenious way in which temporary steel scaffolding has been utilized to provide the framework for the building and to support the Burgess exhaust silencers. Naturally, in such an undertaking it is essential that the air supply to the men working underground should be maintained at all costs and for this reason standby Diesels have been provided for automatically starting and taking over the load should the outside electricity supply to the blower motors fail.

Each station has two four-cylinder Petter two-stroke Atomic Diesels, each capable of developing 224 bhp. a 410 rpm. Each motor-driven compressor carries a Vee-rope pulley on a centrifugal clutch, which is located between motor and compressor. The centrifgual clutch is so arranged that it engages when the pulley is rotated, but remains free if the pulley is stationary, that is, when the motor is driving the compressor. Thus, in normal service the engines are stationary, as are the Vee-ropes, and the centrifugal clutch is disengaged. By an ingenious arrangement of mechanism designed by Petters, Ltd., should the power to the blower motors fail the main engines are immediately started up, while at the same time the principal bearings of the engine are flooded with lubricating oil. As soon as the engine fires the starting air to the cylinders is cut off.

When we visited the station illustrated we had the opportunity of seeing the mechanism tested and it functioned perfectly. In fact, so responsive was the automatic starting device that the blower never stopped in the change-over from electric to Diesel drive. It should be mentioned that the second powerhouse is almost identical with the one illustrated, there being two Petter engines of the same power therein.

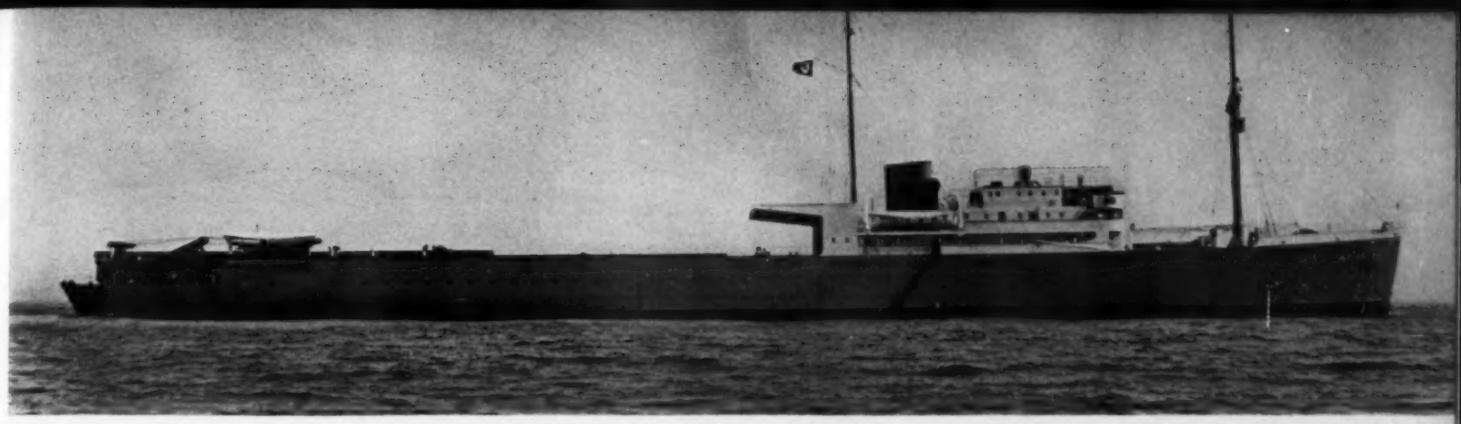
The recent peregrinations of the oil-engined vessel *Girl Pat* served to show that the modern small Diesel-engined vessel is capable of covering long distances with reliability. Another meritorious performance has recently been put up by the new Glasgow-built motorship *Lady Sylvia*, which is 105 ft. long and is propelled by a National six-cylinder high-speed Diesel engine of 220 bhp. This drives a single screw through an oil-operated reverse-reduction gear. The engine room also houses a National engine of 28 bhp., which drives a dynamo compressor and general service pump.

Built for Vancouver owners, the vessel made the trip from the Clyde to British Columbia without mishap or incident of any sort, covering the first 1,800 miles to Las Palmas in ten days. After a short stop here, the Atlantic passage and the run down to Colon, at the entrance to the Panama Canal, was completed between May 17 and June 7, a distance of 3,800 miles. After passing through the Canal the *Lady Sylvia* proceeded up the West Coast of North America and called at Wilmington, Cal., for fuel on June 30, this section of the run being some 2,800 miles. The final stage of 1,200 miles was completed without mishap and she arrived at Vancouver on July 12. This performance by a 200-ton vessel is very good because on the last part of the trip heavy seas and head winds were encountered for eight days. Actually, the engine was running for nine weeks with but three short stops.

Mr. W. S. Burn

THE technical contributions to Diesel progress of my old friend, Mr. W. S. Burn, M.Sc., are well known to a wide circle of American engineers, principally because he is the designer of the only truly all-British large marine Diesel engine, namely, the Richardsons Westgarth two-stroke double-acting unit. This engine is British in conception, design, patents, development and manufacture, and possesses numerous very fine features. Largely because of the depression, Mr. Burn has not made great progress with the application of the engine, although those examples which are at sea have acquitted themselves satisfactorily once their unavoidable "teething" troubles were tracked down. He was not so fortunate, however, in his essay into the stationary engine field, for the small medium-high-speed engine which he produced for stationary work a few years ago was rejected by its buyers because it could not be delivered in time for their requirements. This engine, which is technically satisfactory, notwithstanding the considerable step forward which its design represented when it was evolved about eight years ago, has recently been installed in a small motorship named *St. Germain* and she is at present making trips from this country to the Baltic. I hope to be able to have full particulars of this interesting installation in the near future.

Meanwhile, Mr. Burn is leaving Messrs. Richardsons Westgarth & Co., Ltd., at the end of August and has taken an office at 9 Camomile St., Bishopsgate, London, E. C. His services are being retained as oil engine consultant by Messrs. Richardsons Westgarth & Co., Ltd., and he will also be in close touch with the National Gas and Oil Engine Co., Ltd., for whom he designed a very original two-stroke cycle single-acting engine some short while ago. This engine, incidentally, has been built, but is not yet in the production stage. Like all of Mr. Burn's designs, it possesses some interesting features. It is Mr. Burn's intention to hold himself available for consultation in connection with all problems of oil engine design and manufacture.



The latest addition to Deutsche Lufthansa's fleet of floating bases — the Diesel-powered "Friesenland" with catapult toward the stern.

HOW THE DIESEL ENGINE IS HELPING AVIATION

By PAUL H. WILKINSON

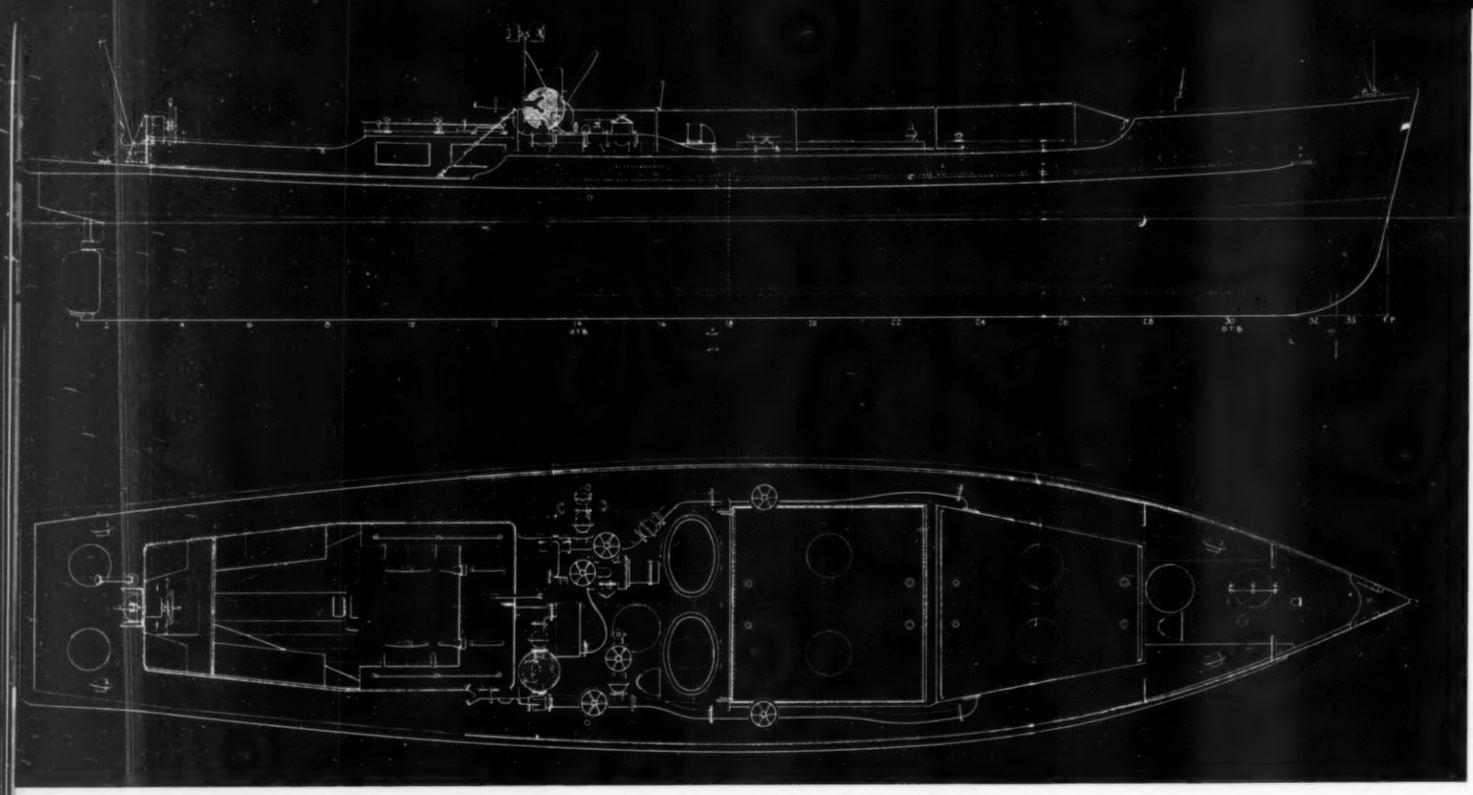
ONCE more, Diesel-engined aircraft are with us, bigger and better than ever! The arrival of one of Deutsche Lufthansa's new seaplanes, the *Nordmeer,* at New York on August 16, marks another milestone in the development and application of this ultra-modern power plant to aviation. Presaging regular 30-hour airmail service to central Europe by way of the Azores for 1938, final steps are now being taken to ensure the successful operation of this service before it is made available to the publiic.

Taking off from Luebeck, near Travemuende on the Baltic Sea on August 11, the *Nordmeer* followed a direct route overland to Lisbon, covering the 1,750 miles "as the crow flies" in 9½ hours at a speed of 184 mph. With Flight Captain Joachim Blankenberg (formerly skipper of the *Zephir,* the first Diesel-engined plane to cross the North Atlantic), in command and carrying three other members in the crew as well as a newspaper man, the *Nordmeer* made record time on the first stage of the trip. The second stage, to the island of Horta in the Azores, was completed on August 13 in 6½ hours, which worked out at 151 mph. for the 980 mile journey. The third stage of the flight, 2,390 miles to the Pan American Airways marine base at Port Washington, 15 miles from the center of New York City, was successfully accomplished on August 16. Encountering a thunderstorm and headwinds up to 40 mph. velocity en route, 16½ hours were required for this long ocean hop which reduced the speed to 145 mph. Thus for the 5,120 mile flight from the northern coast of Germany to New York, 32½ hours of flying time were required, and the average speed for the whole distance was 158 mph.

The *Nordmeer* was catapulted from the *Schwabenland* stationed at Horta and the floating base then proceeded to New York, while the newest addition to the Deutsche Luthansa fleet, the *Friesenland,* took its place at Horta. The new catapult ship is considerably larger than the *Ostmark,* which was illustrated and described in the September, 1936, issue of DIESEL PROGRESS, and is, in fact, about the same size as the *Schabenland.* Built by Howaldwerke of Kiel, the *Friesenland* is of 6,270 tons displacement, with a length of 453 ft. and a beam of 56 ft. Two M.A.N. Diesels of 2,500 hp. each give it a speed of 16 knots. The Heinkel catapult fitted to the stern of the boat has a capacity of nearly 19 tons. Like the other ships in the same service, it is equipped with gymnasium, library and workshops. Capt. Dettmering is in command of this new boat, which is proving so helpful to aviation.

Another interesting way in which the Diesel is helping aviation, is to be found in the new fleet of Diesel-powered fueling launches now being completed for Shell-Mex of London. With the addition of new and larger equipment on the routes of Imperial Airways, it became imperative that the large four-engined flying boats

The "Nordwind," one of the new Ha 139 Diesel-engined seaplanes, about to be hoisted on board a catapult ship.



Profile and plan of an "Empire" fueling launch.

should be fueled quickly from mobile service stations rather than having to tie up at special docks for this purpose. Accordingly, the *Empire* fueling launch, as this extremely efficient piece of equipment is called, was designed and is now being built by firms in England, Egypt, France and Italy. When the fleet of thirty-one launches is completed, they will minister to the needs of flying boats operating between England and Australia and England and South Africa.

The *Empire* fueling launch is of all-steel construction, with a length of 50 ft., a beam of 8 ft. 3 in., and a draft when fully loaded of 3 ft. 6 in. As maneuvrability of the launch, which weighs 28 tons fully loaded, is most important when it is close to the flying boat, the ordinary rudder has been replaced by one of the Kitchen type which is quick-acting and eliminates the need for reversing the engine.

Tankage is provided for 3,000 gal. of gasoline and 240 gal. of lubricating oil. The gasoline is pumped into the flying boat's tanks by means of a Stothert and Pitt rotary pump at the rate of 144 gal. per minute, while it is measured by a 3 in. Kent meter and as a precaution, is passed through a Thompson air separator to ensure that only gasoline is delivered to the tanks. The lubricating oil is transferred to the flying boat by compressed air, the rate of transfer being governed by the temperature of the oil and varying from 8 to 12 gal. per minute.

Although these launches are for fueling gasoline-engined planes, Diesel engines were chosen for their propulsive and pumping plants. Four different makes of engines will be used, all of the four-cycle type and of approximately the same power, except those for launches which will operate in strong river currents where a more powerful engine is necessary. Contracts have been placed for Ruston 4 V.R.B.M. (36 hp.), Widdop D.3 (40 hp.), Paxman-Ricardo 4 M.R.W. (40 hp.), Thornycroft R.J.4 (48 hp.) and Thornycroft RL/6 (72 hp.) Diesels for the fueling fleet.

Still another case of the utilization of the Diesel to assist aviation, is to be found in the floating dock used by the Syndicato Condor airline at Rio de Janeiro for servicing their aircraft. As the tri-motored seaplanes used for coastal service in South America are quite heavy, weighing as much as 9 to 10 tons without their payload, the advantages of a dock to lift them clear of the water for servicing are obvious. The dock itself is 71 ft. long and 47½ ft. wide, and weighs 220 tons. The operating plant, which consists of a two-cycle, two-cylinder Deutz Diesel of approximately 20 hp. coupled to an Amag-Hilpert centrifugal pump of 264 gal. per minute rating, is capable of raising the airplane clear of the water in eight minutes. The maximum lifting capacity of the dock is 16½ tons.

Recently, an example of Diesel fuel economy came to hand which will be hard to beat. The occasion was the opening of the new airport at Stavanger on the west coast of Norway by His Majesty King Haakon VII, to which the Junkers Corp. were invited to send one of their *Ju 86* transports equipped with *Jumo 205-C* Diesels. The plane was flown from the factory

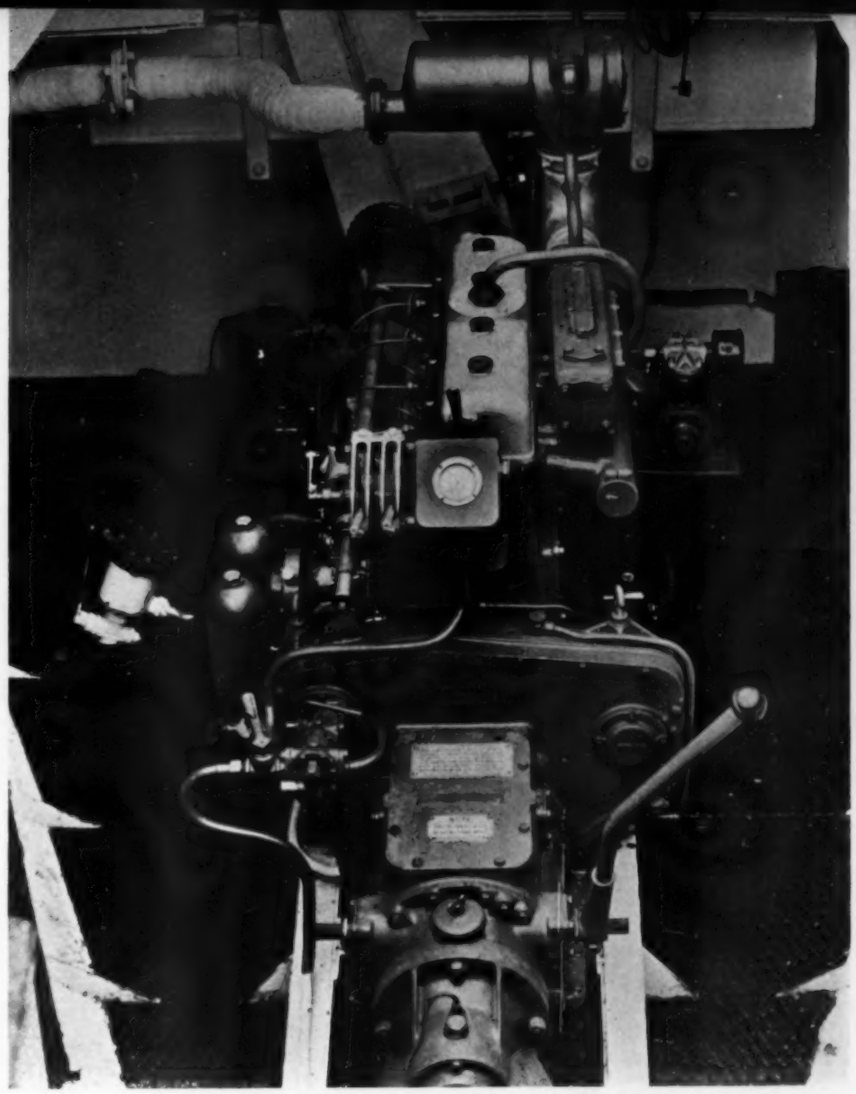
One of Shell-Mex's fleet of 31 fueling launches — Diesel-powered, of course.

at Dessau non-stop to Stavanger, a distance of 590 miles, in 3 hours at a speed of 197 mph., and a careful check of the Diesel fuel consumed en route revealed that the cost of this was only 37 Reichmarks, or $14.80. Worked out on a basis of a full complement of 10 passengers in the plane, the fuel cost was thus $1.48 per passenger for the entire journey, or $0.0025 per passenger mile. Here's something for our American airline operators to think about—will gasoline operation ever be able to equal this?

Now that aircraft fly on schedule through rain and shine, the question frequently is raised as to what would happen to an airplane should it be struck by lightning. Recently, the radio operator on a Junkers *Ju 86* transport plane flying from Hay to Melbourne in Australia had an opportunity to witness such a rare phenomenon and live to tell the tale. While flying at a height of 4,000 ft., the airplane entered a huge bank of clouds and suddenly a yellowish red light about 2 ft. in diameter appeared on the nose of the fuselage. Lighting up the cabin as with a magnesium flare, the apparition disappeared without any of the occupants or crew perceiving any signs of an electrical discharge. Upon landing, however, a careful check of the plane revealed that a small piece of metal about an inch in diameter had been melted away from the covering of the port rudder, indicating that the lightning had struck there and had passed through the craft to the foremost part of the nose where the flash was seen as it left. Fortunately, the plane was equipped with Junkers *Jumo 205-C* Diesels using non-inflammable fuel—one shudders to think of what might have happened, however, to a gasoline-engined plane under similar circumstances.

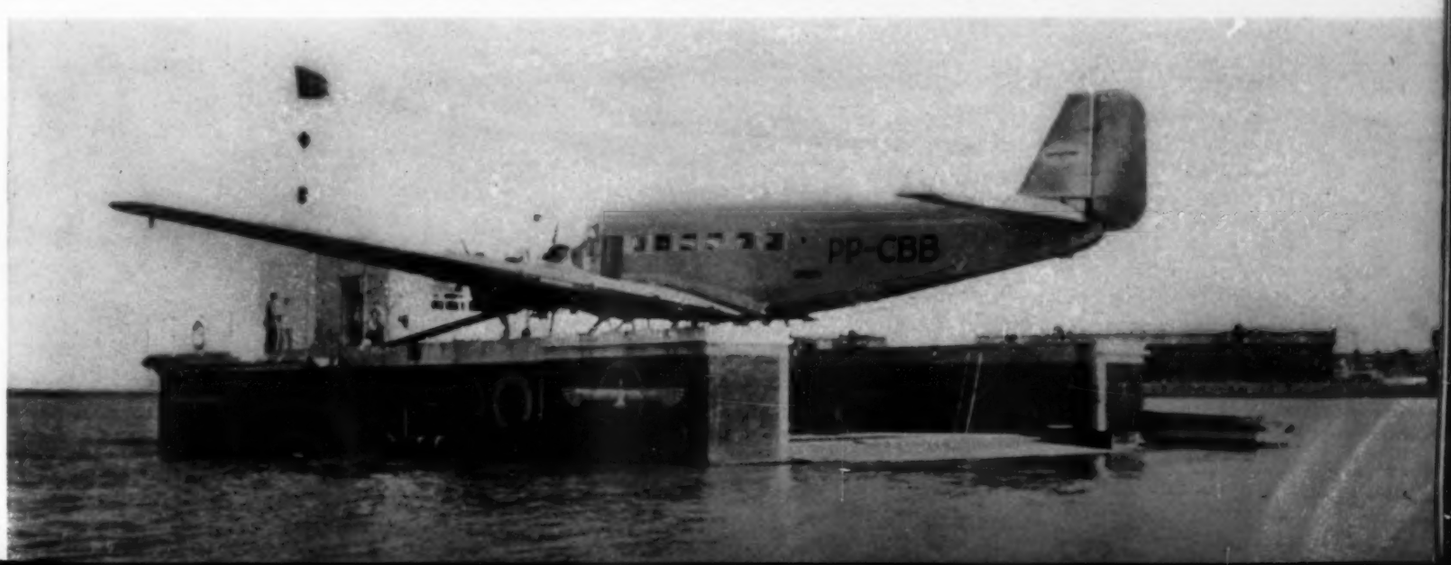
Talking about lightning striking airplanes in flight, one cannot help wondering whether this was not the fate of the K.L.M. airliner which was lost near Brussels on July 28. According to eyewitnesses, the gasoline-engined *Douglas* took off and was lost to sight in a dense black cloud and when next seen, was diving to earth with the left wing enveloped in flames. The plane crashed with tremendous force, the motors and part of the fuselage being entirely buried in the ground, while the explosion of the gasoline tanks was heard for miles around. All of the 14 occupants of the plane, including three Americans, were killed and it can only be concluded that an explosion in mid-air was responsible for the tragedy.

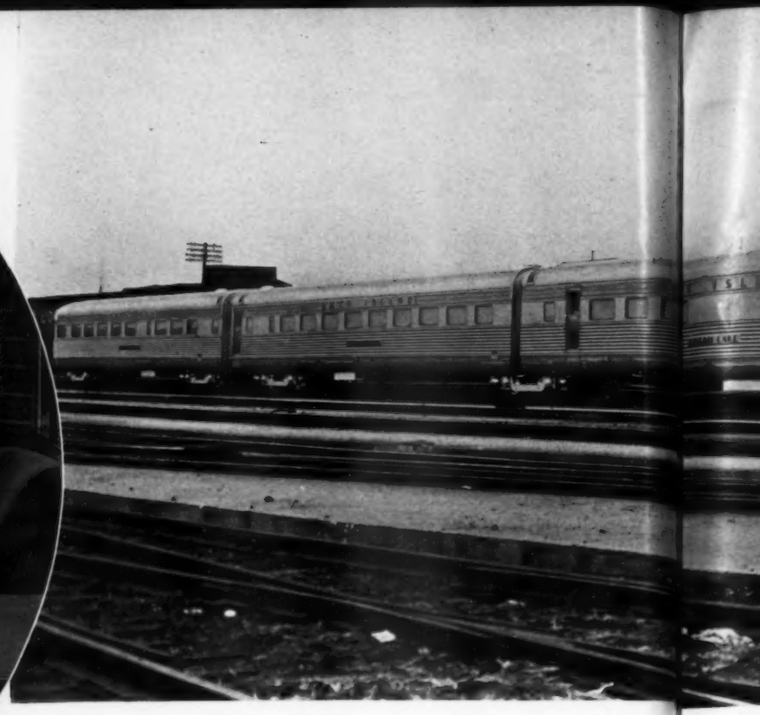
Incidently, the wreck of the gasoline-engined Pan American-Grace airliner off Panama on August 3, when 14 lives were lost, might have been due to a similar cause. According to the official navy dispatch issued after an examination of the wreckage towed to the Coco Solo naval base: "Evidence of fire found on part of the wreckage indicates there was an explosion in the plane at the time of the crash." But did it never occur to our naval authorities that fire and water do not mix, and that it would be more logical for the explosion and fire to have occurred *before* the crash and, in fact, to have been directly responsible for it?



Thornycroft 4-cylinder Diesels are used for propulsion and pumping purposes aboard some of these launches.

Syndicato Condor's floating dock at Rio de Janeiro, equipped with a Diesel-operated pumping plant.





Edward G. Budd, left, president of the Edward G. Budd Manufacturing Co. of Philadelphia, which built the "Rockets," is pictured with his chief engineer, Colonel E. J. W. Ragsdale, going over the plans in a last minute inspection of these newest Diesel streamline trains. The photographs were taken of the first unit to be deliverd and the composite photo and artist's drawing depicts the finished fleet.

ROCK ISLAND ROCKETS

SAFETY and dependability under all operating conditions have been prime considerations in the design and construction of the six Diesel locomotives for the new *Rocket* streamline trains of the Rock Island Railroad. Provisions for maximum speed of 117 miles an hour and operating economy have been dovetailed with the requirements for safety and dependability.

The locomotives, the first of which has just been delivered from the plant of the Electro-Motive Corporation, subsidiary of General Motors Corporation, at La Grange, Illinois, represent the latest developments of the engineers of this pioneer in Diesel locomotives for main line service, backed by the scientists and facilities of General Motors Research Laboratories at Detroit.

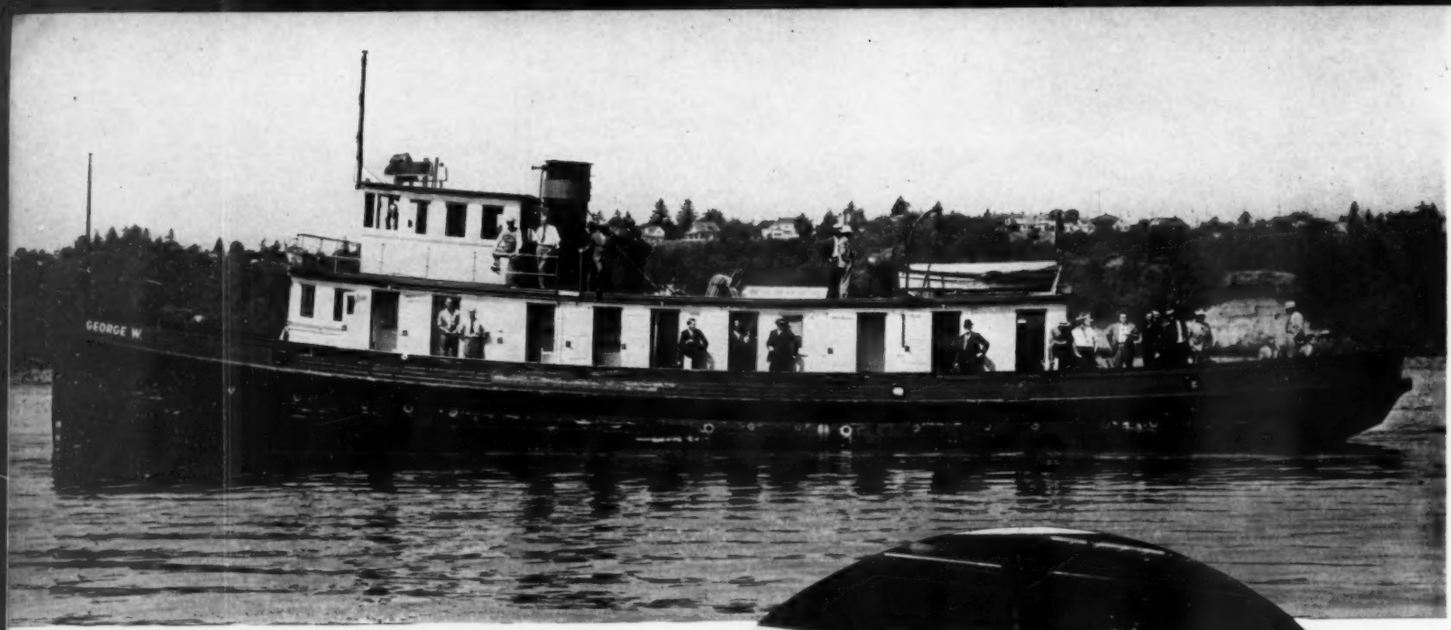
The locomotive is equipped with a sixteen-cylinder V-Type two-cycle 1,200 hp. Winton Diesel engine. The power generated by this plant is transmitted through a direct current electric generator and four traction motors, two to each wheel truck. Train heating equipment is located in the locomotive, comprising two automatic oil burning boilers.

The locomotive has a fuel tank capacity of 1,020 gallons. Under normal operating conditions it uses slightly less than a gallon of fuel oil per mile at an average speed of 75 miles per hour. These trains are intended to haul passengers with the greatest possible speed, comfort and assurance of reaching their destination, and there has been no compromise with the fundamental requirement that safety is paramount. The control cab is placed so that the engineer and fireman have the maximum clear view of the track from a high vantage point at the front of the locomotive. Controls are simpler than those of the ordinary automobile. In fact it takes less effort to start and stop the train than it does to start and stop an automobile.

Overall length of the locomotive is sixty-two feet, four inches; width nine feet, ten inches; height from the rails to top of roof, thirteen feet, eleven inches. It has two trucks. There are eight thirty-six inch driving wheels. Its approximate weight with one-half running supplies aboard is 220,000 pounds.

The "Rocket" appearance is obtained by the coloring of the front end of the locomotive with alternating, streamlined bands of maroon and vermillion, augmented by silver stripes. This treatment is carried back the length of the locomotive where it blends into stainless steel, of which the passenger cars are constructed. The effect of the train in full flight in open country is suggestive of a bullet shaped ball of fire leaving a silvery white-hot wake.

ROCK ISLAND
THE ROCKET
ROCK ISLAND
ROCK ISLAND
THE ROCKET

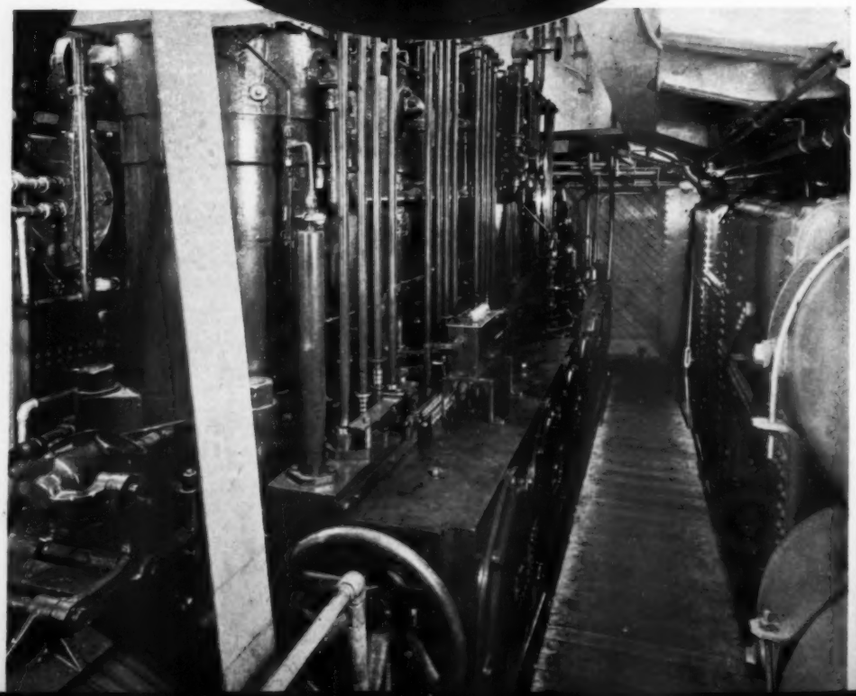


GEORGE W LARGEST COLUMBIA RIVER DIESEL TUG

By CHAS. F. A. MANN

COMPLETION of the conversion of the historic U. S. Engineers famed Columbia River workshop, the *George H. Mendell,* into the largest Diesel tug on that historic river took place in June and the re-named tug, *George W,* was delivered to her owners, the Shaver Transportation Company, in record time.

With a fine hull already proved successful in navigating the Columbia from The Dalles to Astoria, the *George W* represents almost as large a job as the actual building of a new vessel. She is 93 ft. 3 in. long, 20 ft. beam, and 9 ft. 9½ in. depth, and of 117 gross and 41 net tons. Originally built in 1889, she was



rebuilt in 1912 and again in 1931, each time the heavy fir and cedar timbers being reworked until she was practically as good as new. Her old steam plant, weighing twice as much as the new Diesel, was finally junked and the more powerful Diesel plant fitted into the hull on a rebuilt foundation of fir engine timbers 22″ x 24″ and 60 ft. long. Veritable girders were these huge timbers, each weighing over a half ton.

The main engine is a 6-cylinder Atlas Imperial direct reversible marine Diesel engine, developing 480 hp. at 275 rpm. and her auxiliary plant, of novel design, revolves around a 4-cylinder Atimco 40 hp. Diesel, another of the Atlas line. The main engine has cylinders 14½ in. bore and 18 in. stroke while the little but faster Atimco set his cylinders but 4¾″ x 6½″. The auxiliary is compactly mounted aft in the engine room delivering its power direct to a 10 kw. 125-volt generator, via a clutch, and through a short jackshaft and Allis Chalmers V-belt drive and clutches to an Ingersoll-Rand centrifugal pump of 600 gpm. capacity and a 31 cfm. Ingersoll-Rand 2-stage V-type air compressor. There are six 30″ x 96″ air storage tanks for air operation of the towing winch, which has 1,200 ft. of ¾ in. cable for towing logs and barges – the air steering gear and reversing of the main engine. The main engine is direct reversible and is connected to a three bladed 79 in. diameter, 57 in. pitch, manganese bronze Johnson propeller, made by the Johnson Propeller Works of Portland, Ore. Auxiliary engine foundations were fabricated by the Commercial Iron Works of Portland. A 5 kw. generator set is belt driven off the main engine.

Six air receivers 30 inches in diameter and 96 inches long are carried for large compressed air storage for operation of deck machinery and steering gear. Originally these were steam and have been adapted to compressed air by slight changes. Two fuel tanks, one on each side amidships, with a capacity of 1,250 gallons each. The entire boat is equipped with Foamite fire protection beside having a Cameron general service pump with a capacity of 400 gpm. against 60 lbs. pressure. The steering engine is a single piston and cylinder six inches in diameter and 5 foot stroke.

Elaborate quarters are fitted for a crew of eight, including Captain, River Pilot, Chief and Second Engineers, three deck hands and a cook. The crew is quartered on the main deck while the Chief and Second Engineers are quartered below, aft.

In the galley there is a Lang oil burning range and electric ice box and hot water system.

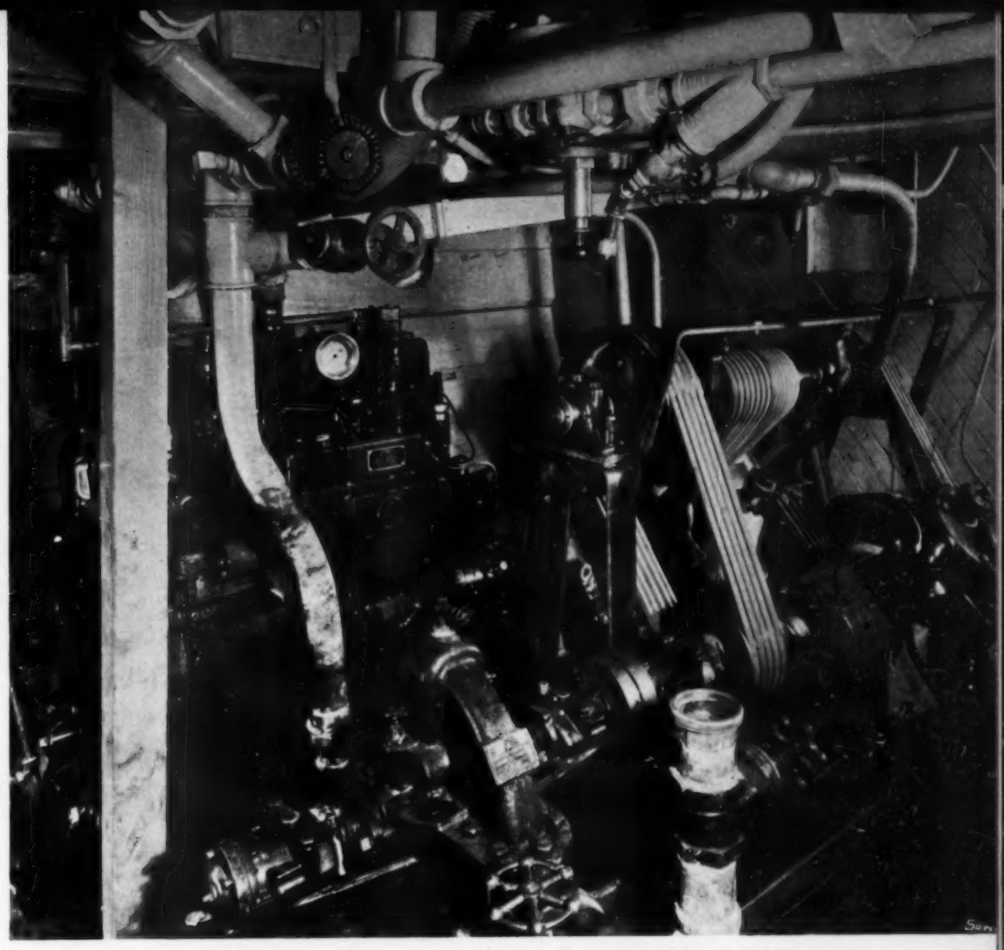
Hull rebuilding was done by the Portland Shipbuilding Company who have done many other jobs on this vessel in her lifetime.

The new tug logged 15 statute miles on trials and will go to work immediately towing barges for the Shaver Transportation Company. The founder of the Shaver Company, Mr. George W. Shaver, lends his name to the new tug. The original Company was founded in 1882 and incorported as the present organization in 1893, or almost exactly coincident with the time of building the original steam tug, the *George H. Mendell*, for the U. S. Engineers heavy work program on the building of the famed Columbia River Channel from Portland to Astoria, which took nearly 40 years to finish.

The Shaver Transportation Company now have 13 tugs powered with Atlas Imperial Diesel engines, totalling 16, ranging from 3-cylinder 50 hp. to the big 480 hp. Atlas in the new tug. Their first Atlas was purchased in 1921, with more purchased almost annually ever since. They are one of the largest Atlas users in the Pacific Northwest. The company is now operated by Capts. Homer T. and Leonard R. Shaver and is the largest operation of its kind on the entire Columbia-Willamette River system.

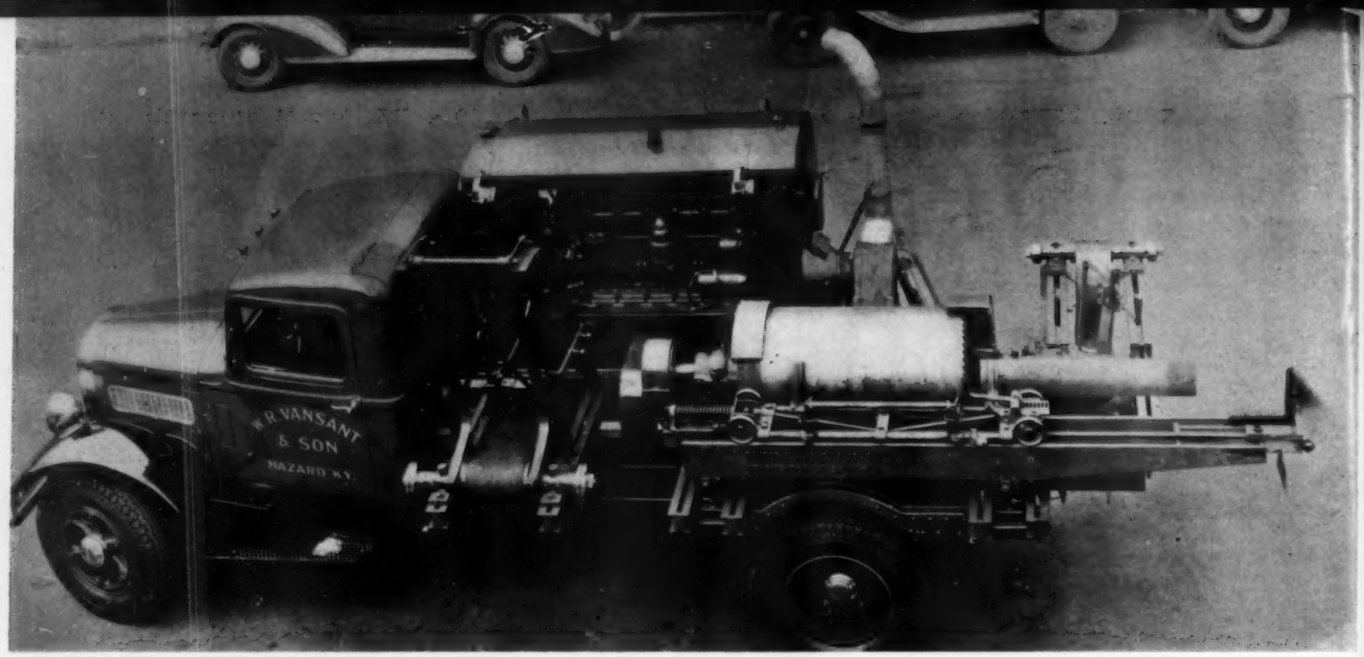
Installation and supervision of the work of conversion was done by Mr. A. C. Fries, Portland manager for Atlas Imperial, who has had a large share in Dieselization of the hundreds of vessels in the Pacific Northwest.

Thus another Diesel vessel is added to the ever-growing Northwestern United States fleet boasting this type of economical and dependable power. Both in new boats and converted existing craft, the Diesel engine is assuming a greater and greater share of the marine commerce in Pugent Sound and adjacent rivers as well as in the entire Pacific coastwise and harbor service.



The Atlas 40 hp. auxiliary unit which drives two pumps, a generator and air compressor all through a compact V-belt drive.

The 480 hp. Atlas Imperial Diesel powered tug on trials, her hand wheel for close navigating in the Columbia River and close up of main engine.

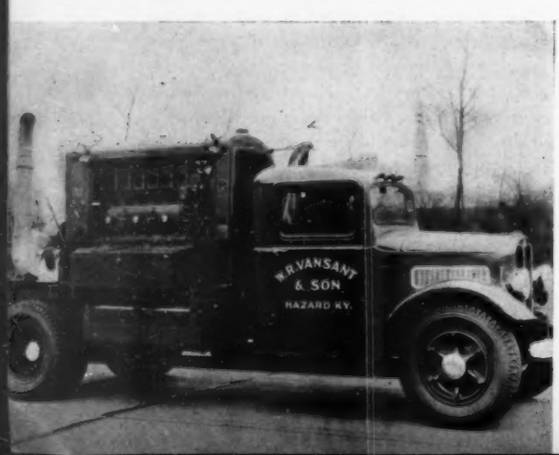


MOBILE DIESEL STAVE MILL

WITH the repeal of prohibition, competition among manufacturers of whiskey barrel staves became so strong that W. R. VanSant & Son of Hazard, Ky., were obliged to apply their ingenuity to the problem of cutting manufacturing costs.

They had been using a steam engine to drive their equipment, which was quite satisfactory in so far as fuel was concerned, because they burned sawdust and waste wood. There was, however, this objection: the engine was so bulky that the cost of moving was exorbitant, and moving was necessary frequently.

Moreover, with steam power this plant had to be located near a good water supply regardless of the distance to the timber supply, and oftentimes a satisfactory supply of water was difficult to locate. When a good supply of timber was located quite a distance from the water supply there was, of course, considerable expense involved in hauling bolts to the mill, in addition to that of hauling the staves to the railroad.



Investigation of the possibilities offered by other types of power led to the purchase of a Fairbanks-Morse 60 hp. Diesel engine. This proved so successful that the VanSants decided to carry the economy program further, and they investigated the possibility of making their equipment easily portable.

Fairbanks, Morse & Co. and the Schacht Truck Co. worked with the owners in designing and building what is believed to be the only outfit of its kind in the country, the "Gypsy Stave Mill."

The complete equipage consists of a Schacht 3-ton special body truck, upon which is installed the Diesel connected to a steel line shaft through a Link Belt silent chain. The line shaft is suspended on SKF pillow blocks and ball bearings underneath the machinery supporting channels. The chain is enclosed in an oil-tight housing to which lubrication is furnished by a rotary pump, driven from the line shaft by a sprocket chain. The stave mill is driven from the line shaft through another Link Belt silent chain, which is also enclosed in an oil-tight housing. Equalizer saw, listing saw and blower are driven from the line shaft through flat belts. The battery used for both starting the engine and supplying light is located in the box on the operating side of the engine. A reserve fuel oil tank is located under the battery box.

This outfit is complete in every respect, consisting not only of the truck with all the machinery mounted on it, but camp cars for men and a kitchen car equipped with a coffee roaster in which charcoal sticks for aging whiskey will be made from waste wood.

With this mobile barrel stave manufacturing equipment, the owners now can travel all over the country, working in either small or large tracts of timber, any place near the point an order is to be filled. This modern, easily portable plant has considerable advantage over a stationary unit through reduced carriage expense. Completed staves will be hauled by truck to the customer, cutting down freight charges and long distance hauling. Moreover, this plant can be operated economically in small tracts of timber where it would not pay to install a stationary outfit.

In whiskey barrel stave mill operation, white oak timber is first located, trees are chopped down and bolts measuring from 36 in. to 42 in. are cut up and split into blocks. These are hauled to the mill, where they are first put through the equalizer saw located immediately back of the truck cab. As blocks come from the equalizer saw in the desired length, they are put on the barrel stave mill carriage and are fed into the mill. Staves come out of the mill and are passed over to the listing saw, where their edges are trimmed.

DIESEL ENGINES

By JOHN W. ANDERSON

No. 7. ALCO-SULZER—TYPES "T" AND "TM"

This engine description is one of fifty-seven which appear as one section of the DIESEL PLANBOOK and ENGINE CATALOG, Volume II

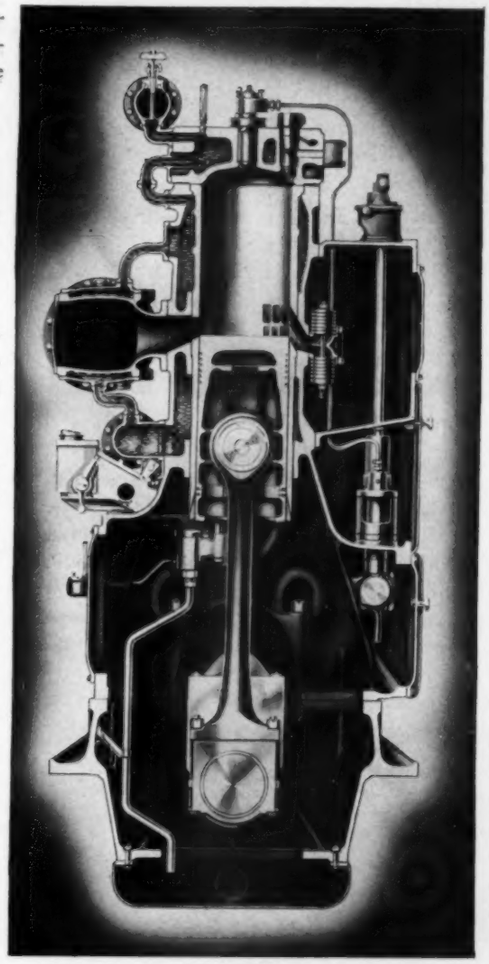
THESE two cycle, trunk piston solid injection Diesels are designed for heavy duty stationary and marine service, with a power range and size as shown in the table.

No. of cyls.	Bhp.	Rpm.	Bore	Stroke
4	720	277	14″	23½″
5	900	277	14″	23½″
6	1080	277	14″	23½″
8	1440	277	14″	23½″
10	1800	277	14″	23½″

Among the many interesting points in the design of these engines, perhaps the most important are the system of scavenging and the fuel injection system.

The scavenging method employed is that developed originally by Sulzer many years ago and perfected since then by many years' experience. It is best understood by referring to the four figures in the diagram. Starting with Figure I, the piston is moving downward on its power stroke, expanding the gases of combustion of the fuel. The scavenging air ports are somewhat higher than the exhaust ports and, therefore, the former are the first to be uncovered by the downward motion of the piston. But the check valves are held closed by the pressure of the gases in the cylinder, and there is no escape of these gases into the scavenging air receiver.

As the piston continues downward, the exhaust ports are uncovered, permitting the cylinder gases to escape into the exhaust header. The pressure quickly drops to about atmospheric,



Cross section of the Alco two cycle Diesel.

and the pressure in the scavenging air receiver opens the check valves, permitting the flow of fresh air into the cylinder to flush out the exhaust gases and at the same time charge the cylinder completely with fresh air. Figure II shows this process at its height while the piston is at bottom center.

Sulzer has highly developed the details of this process in order that it may be carried out efficiently as well as completely, for the efficiency of the engine and the power obtainable are dependent upon it. There are two rows of ports, one above the other, for the scavenging air, and they are both controlled by the check valves shown. The individual ports are carefully sloped and shaped to direct the air flow upward along the adjacent cylinder wall, before it is turned at the top of the cylinder by the head to flow downward on the far side. Such a flow plus a certain amount of direct flow across the cylinder, sweeps every portion of the cylinder space and thoroughly clears it of exhaust gases.

After passing bottom dead center, the piston starts on its upward or compression stroke. The scavenging and charging process continues until the top edge of the piston covers the exhaust ports as shown in Figure III. But the fresh air continues to flow into the cylinder from the scavenging receiver due to the higher pressure there, and thus the charging of the cylinder continues.

In Figure IV, the piston has closed both the exhaust and scavenging ports, and the air charge

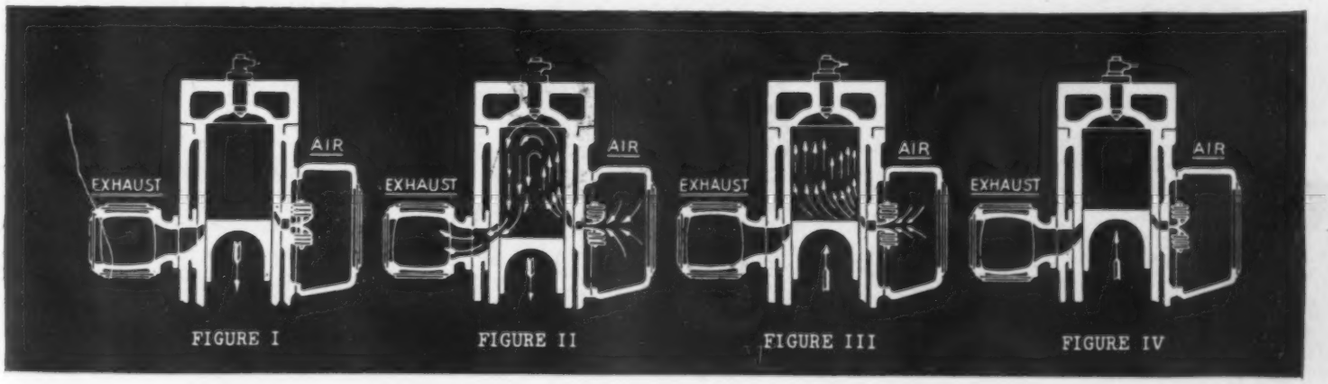
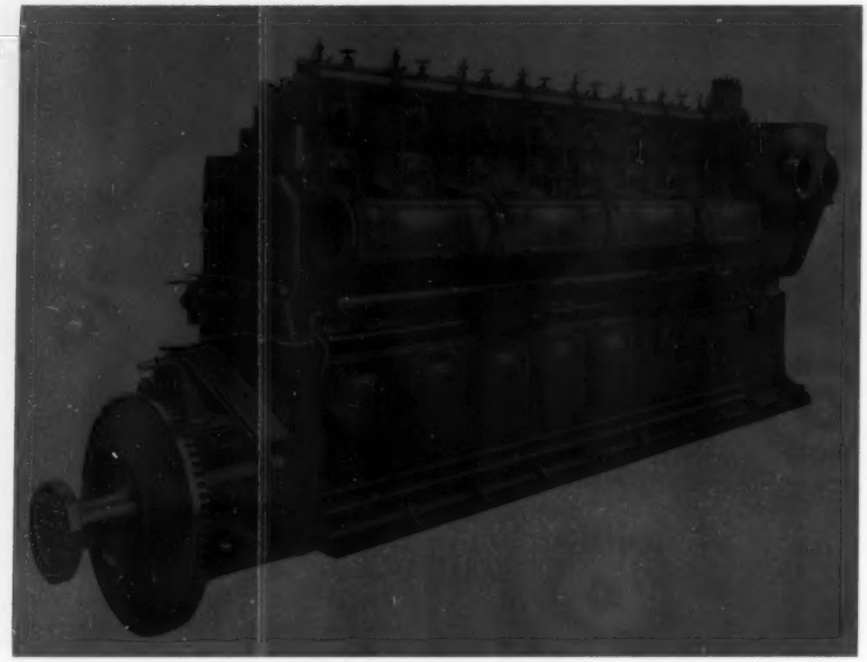


FIGURE I FIGURE II FIGURE III FIGURE IV



Alco Diesel type 8-TM 36 rated at 1,440 hp. at 277 rpm.

trapped in the cylinder is greater in volume than the effective stroke volume of the cylinder at atmospheric pressure. This extra air assists the load carrying capacity of the engine. Then the piston continues on its upward stroke, compressing the air for the next injection of the fuel and the next power stroke.

For the fuel injection system there is an individual fuel injection pump for each cylinder. It is located opposite its own cylinder and driven from the camshaft as shown. Enclosed, yet easily accessible during operation by removing the cover in front of it. With this arrangement, the length of high pressure tubing is the same for every cylinder and thus the injection conditions are the same for all of the cylinders.

Also type TM Marine Diesel direct reversible.

The fuel injection pump is of the type where the quantity of fuel injected is controlled by the seating of the suction valve. This valve is mechanically operated, and the longer it is held off its seat, the less the quantity of fuel injected. In the direct reversible marine engines, this setup is particularly advantageous. The fuel cam is made symmetrical in shape, and the cam is so keyed on the camshaft and timed that the top of the cam, and thus the end of the pump plunger stroke, coincides with the upper crank dead center. Since the suction valve motion is obtained from the pump plunger motion, it is unnecessary to reverse the fuel pump when reversing the engine – it works equally well in either direction of rotation of the cam and engine crankshafts.

The fuel injection valve is hydraulically operated from the fuel injection impulses. It has a spring loaded differential area needle valve, and a multihole nozzle for distributing the fuel jets in the combustion space in the cylinder. These injection valves are water cooled by a special fresh water circuit hooked up for this purpose.

The combustion chamber is formed between the perfectly flat piston top and the domed cylinder head. The smoot flat piston crown exposes the smallest area possible to the heat of the combustion, and thus there is the least possible loss of heat in this direction and the smallest amount to be carried away by the piston cooling medium.

Turning now to the other features of these engines, there is the cast iron base of rugged design in one piece for the entire engine. The foundation supporting flanges run along both sides as shown. They are wide and well ribbed in their attachment to the base. The cross girders support the main bearings and provide bosses for the studs which take most of the gas load from the cylinders and tie the cylinder block to the base. These studs are seen in the sectional view either side of the main bearing.

The cast iron cylinder block is also in one piece for the entire engine, and includes the upper crank case as well as the jackets and supports for the cylinder liners. This piece has many functions and its proportions and details can be seen from the general views of the engine and the cross section. There are the strength members to give mechanical strength and rigidity. The water jackets for the cylin-

ders extend the entire length of the cylinder liners. These removable liners are held at the top by the cylinder heads, and are free to expand with changes in temperature at the bottom, but these lower joints are made water tight. There are the scavenging and exhaust ports formed to connect with the corresponding ports in the cylinder liners. There are the camshaft bearings, in the cross frames over the main bearings. And there are the large openings along the sides for access to the crankcase space.

A trunk bolts to the front of the block and forms the scavenging air receiver. The space below it and above the outside surface of the side of the cylinder block serves as the enclosure for the fuel injection pumps. The exhaust header is bolted to the back of the cylinder block. The whole effect is to obtain a self-contained rigid engine structure with a smooth exterior enclosing the engine parts, yet with quick and easy accessibility to all of them.

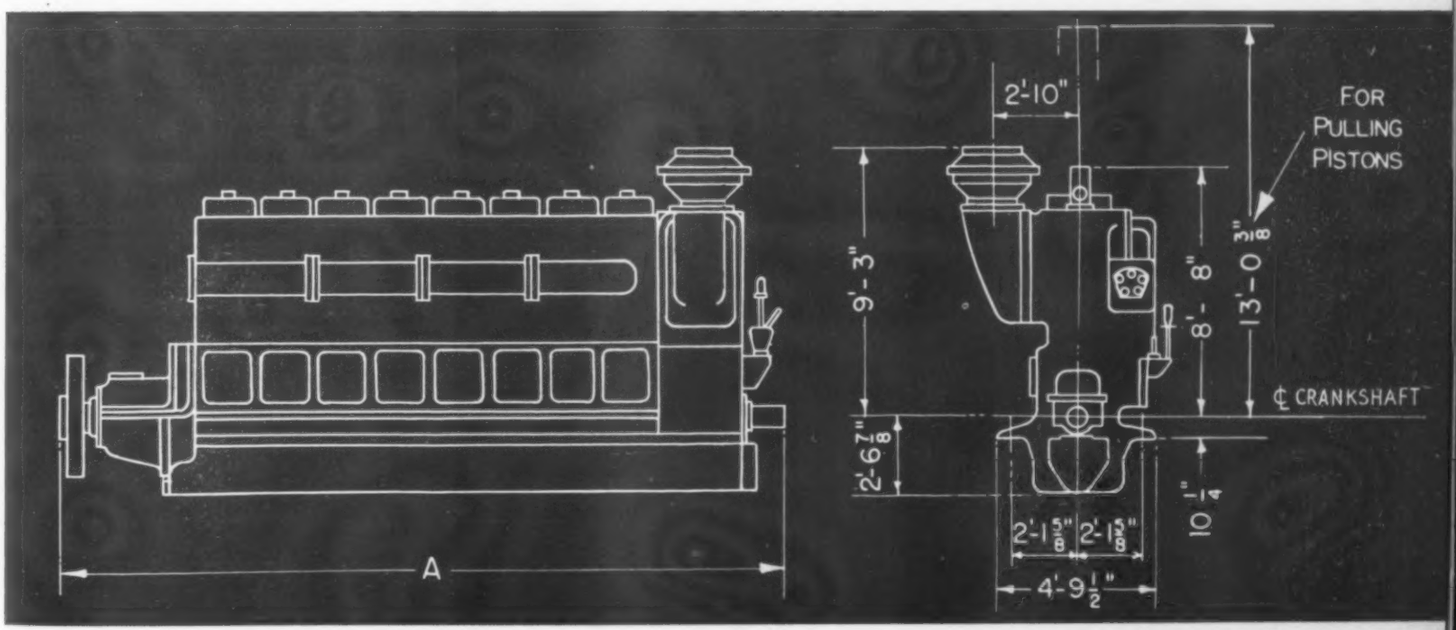
The cylinder heads are individual castings of symmetrical design bolted by studs to the top of the cylinder block. The fuel injection valve is in the center of the head, and the air starting valve is at one side towards the front of the engine. Observe the nozzle inside the water jacket on the water inlet which directs the incoming flow towards the center surfaces of the head and the boss around the injection valve to ensure adequate cooling in those regions, which are, of course, the hottest parts of the cylinder head.

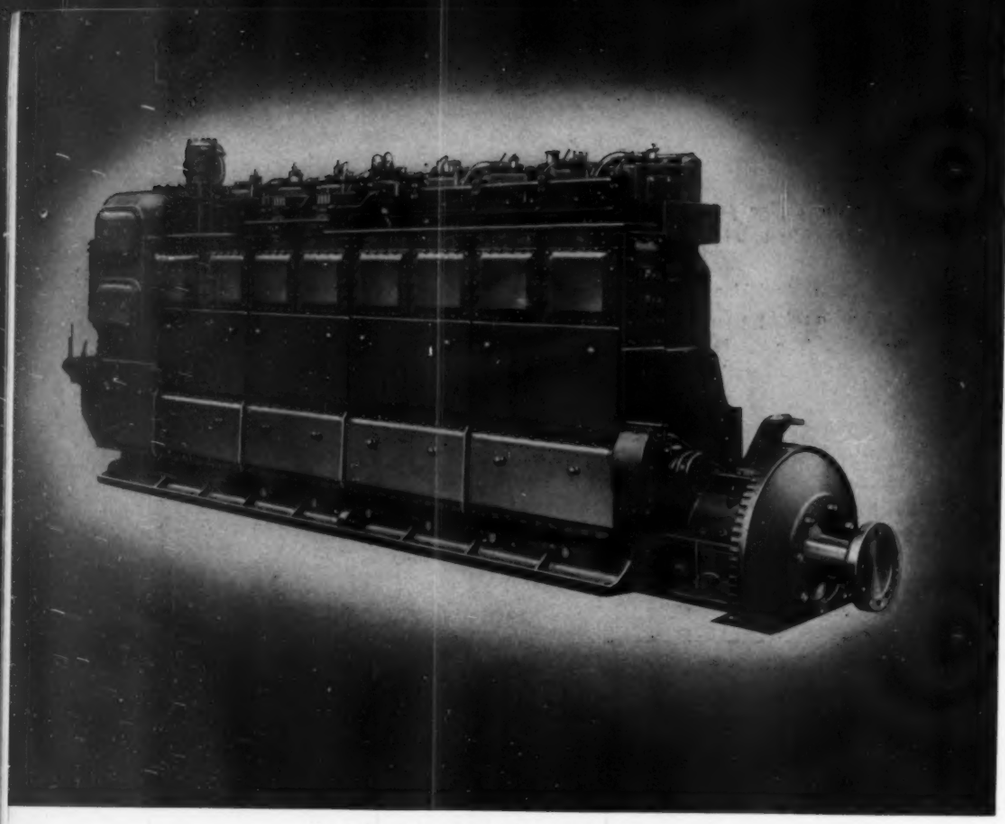
Main and crankpin bearings are interchangeable with babbitt lined removable shells. The lower end of the connecting rod is of the marine type with cast steel boxes. The upper end has a bronze bushing for the wrist pin bearing. Wrist pin is held in the piston by a dowel pin. The cast iron trunk piston is well ribbed to keep it round and has a division plate just below the inside of the crown to set off the space for the cooling liquid.

The camshaft is driven by helical gears from the flywheel end of the crankshaft. Separate cams fastened to the shaft drive the fuel injection pumps. The air starting timing valves located on the top of the scavenging receiver casing are driven by a vertical shaft driven off the main camshaft.

Scavenging air is supplied by a two piston, double acting, crosshead type vertical pump at the end of the engine, with feather type valves. The pump is driven from an extension of the

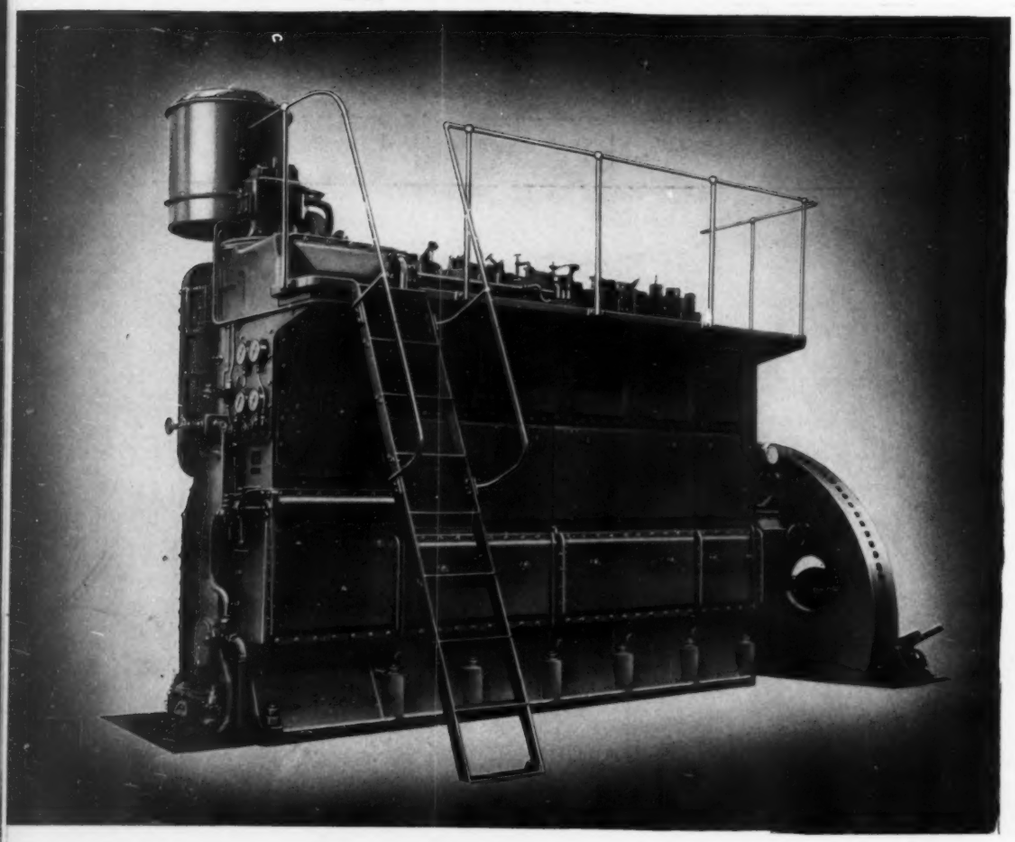
Type	R. P. M.	B. H. P.	Bore	Stroke	Weight	Dimension A
4—14 x 23½	277	720	14	23½	60,000	16′—4″
5—14 x 23½	277	900	14	23½	70,000	18′—3⅝″
6—14 x 23½	277	1080	14	23½	82,000	20′—3¼″
8—14 x 23½	277	1440	14	23½	105,000	24′—2½″
10—14 x 23½	277	1800	14	23½	128,000	28′—11⅝″





Alco-Sulzer type TM eight cylinder 1440 hp. marine engine.

Alco-Sulzer type T five cylinder 900 hp. stationary engine.



crankshaft. The air from this pump passes directly into the scavenging receiver and through the ring plate check valves into the cylinders as already discussed.

The header for the cooling water supply runs along the back of the engine, with branches into the bottom of each cylinder jacket. There are separate bypasses from the supply header up through the exhaust header jacket and into the upper part of the cylinder jackets as shown. Then all of the water passes through the cylinder head jackets and into the outlet header along the top of the engine at the back of the heads. All water connections from one part to another are outside connections to prevent possibilities of damage due to leakage. Note the thermometer at the outlet from the cylinder head, and the control valve in the outlet header. The piston cooling circuit is part of the lubrication system.

An engine driven rotary pump takes lubricating oil from the sump and sends it through the strainer and oil cooler to the headers which supply the bearings and the piston cooling circuits. From the main bearings, the oil passes through the drilled crankshaft to the crankpins, and up the drilled connecting rods to the wrist pin bearings. The mechanical lubricator, seen on the back of the engine near the cooling water inlet header, supplies oil to four points around the circumference of each cylinder. There are two wiper rings on the lower part of the piston skirt which prevent excessive lubricating oil consumption up past the pistons. Cooling oil is passed to and from the piston heads by telescopic pipes of substantial design. The return oil is passed by the pipe shown, down into the oil sump pan on the bottom of the base, while a portion of it is bypassed from the return fitting at the lower end of the telescopic pipe to the thermometer on the outside of the crankcase to indicate the temperature of the returning oil.

Stationary engines run on the Woodward governor which controls the fuel injection pumps. A separate overspeed governor acts to shut off the fuel supply in case the engine exceeds its proper speed. Marine engines run on a flyball type of governor which reacts to load changes to maintain the approximate speed for which it is set by the control at the operator's station. Reversing is obtained by distributing air to the proper cylinders to start the rotation of the engine in the right direction.

The propeller thrust bearing is built in at the after end of the engine, is fully enclosed and is lubricated by the engine lubrication system.

Caterpillar Diesels have long been associated with construction and building. This "Cat" is reversing the process with customary economy.

DIESEL DESTRUCTION

IN the construction of both San Francisco Bay bridges, track-type tractors have played an important role. The Diesel engines powering these machines have set spectacular records for economy and dependability.

In spite of the fact that both bridges are now completed and opened to traffic, a variety of jobs still remain to be done, and the Diesel-powered tractors are still hard at work as a consequence. A fleet of them are helping to build and level the man-made island which will house the 1939 San Francisco Fair. More machines are building roadways and approaches to the island. The new exposition airport is being rapidly brought to completion by Diesel power.

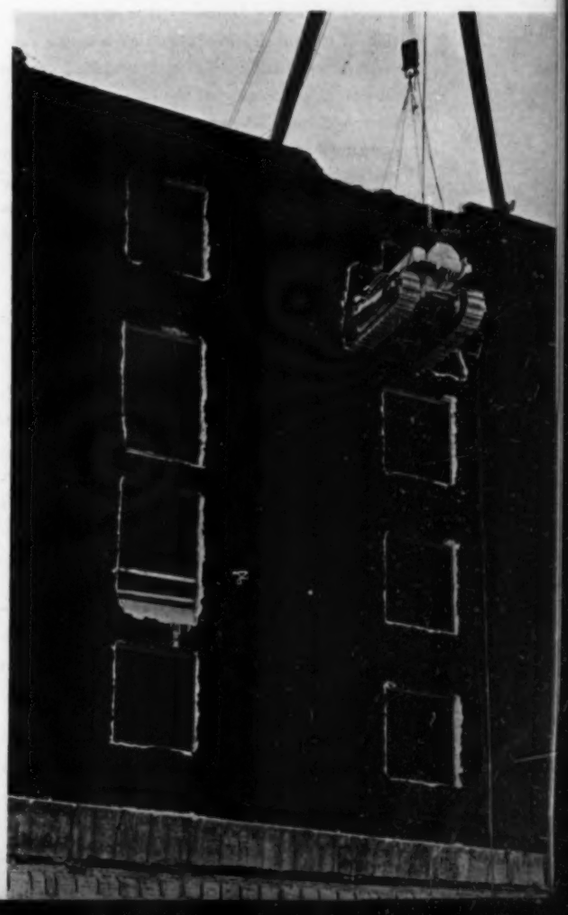
However, on one job, a Diesel-powered tractor not only works economically, but does a difficult and precarious job with utmost success. The job itself is unique enough to be making track-type tractor history, and is perhaps opening a new field for Diesel power. Spectacular as it may be, however, the work is not a stunt. Instead, it is the result of careful planning and sound engineering ideas.

In order to make way for the new San Francisco Bay Bridge Terminal Building, it was necessary completely to demolish a seven-story structure, which was occupying the spot. Looking for an economical and quick method of wrecking the building, the contractor logically selected Diesel power.

First, a crane was hoisted to the top of the building. This machine went to work swinging a heavy steel ball, and knocking the building walls to pieces.

When the walls of the top floor were destroyed, a "Caterpillar" Diesel RD4 tractor, equipped with a hydraulic bulldozer, was hoisted up and went to work cleaning up the debris. Bricks, mortar and other refuse were shoved over the side of the building and allowed to fall to the street below, where they were gathered into trucks and hauled off.

The crane and the sure-footed tractor, working hand in hand, operated downward from the top floor to the bottom, and made quick work of the wrecking job.



LUBRICATION REQUIREMENTS FOR DIESEL ENGINES

By B. J. VON BONGART

THE oil consumption (lubrication) for Diesel engines varies widely and may range from a low of but 0.016 lb. to as much as 0.03 lb. per hph., depending upon engine design, load factor, quality of the lubricating oil, and other factors too numerous to mention. The effective lubrication difference between a suitable oil and an unsuitable one is great indeed, but since the quality or qualities of a lubricating oil do not come within the ambit of our present considerations, we shall concern ourselves with the mechanisms of lubrication rather than with the medium itself.

The assertion often heard "that the oil consumption is normal and that consequently the lubrication is adequate," is meaningless. Oil does not "wear out," but it may emulsify if condensed vapor mixes with it, and it may also become gritty, due to particles of dust and/or minute particles of metal that have mixed with the oil; it then lacks lubricating qualities. The initiated can well conceive an engine in which the oil consumption is well beyond normal if not downright high, and yet the lubrication may be woefully inadequate. High oil consumption merely indicates that a goodly portion of the lubricating oil partakes in the combustion and is thus consumed. While a certain minimum percentage of the lubricating oil perforce will enter the combustion chamber to be consumed there, it is of moment whether or not such oil has performed its duty as a lubricant before it is consumed in the combustion process. And we must always bear in mind that the lubricating oil's mission is to lubricate, and that its partaking in the combustion process is merely an unwanted, albeit unavoidable *addendum* to its real and only duty.

But before we dare speak of adequacy of lubrication, we must first of all analyze the lubrication requirements. In Fig. 1 is shown the lubrication analysis of a typical Diesel engine. That it is for an engine of the 4-cycle type is of no moment, since the requirements for 2-cycle engines are similar if not greater.

The curve "A" indicates the lubrication requirements for different piston resp. crank positions. The need for lubrication e.g., for a film of oil between the piston and cylinder wall, is greatest at a point (or rather line) just below the wrist pin when the piston has traversed one-quarter of its stroke downward. The lubrication requirements are lowest when the piston has reached B.D.C., and they are again lowest when the piston reaches T.D.C., since at these points the piston side-pressure is at its lowest. At T.D.C. the piston, or rather the rings, do not have to withstand side pressure, yet they have to be lubricated in order to minimize friction. Curve "A" ends at the lower piston ring when the piston has reached T.D.C. (Fig. 1) yet oil has to be carried upwards so as to lubricate the piston rings. The requirements for this service are shown in curve "B" Fig. 1. It is usually assumed that a given quantity of oil is carried upwards imbedded between adjacent piston rings, and that this minute amount of oil thus carried, suffices for top lubrication. Just where the oil is to come from to be thus carried upwards has not always been considered. For small (less than 5″ bore and perhaps 6″ stroke) Diesel engines of high speed (1,200 rpm. or over) a large spray of oil-mist emanates from the crank throws due to centrifugal force, but in the case of large Diesel engines of perhaps 20″ bore and 30″ stroke operating at 180 rpm., the centrifugal force is rather low and thus the stream of oil-mist ex-

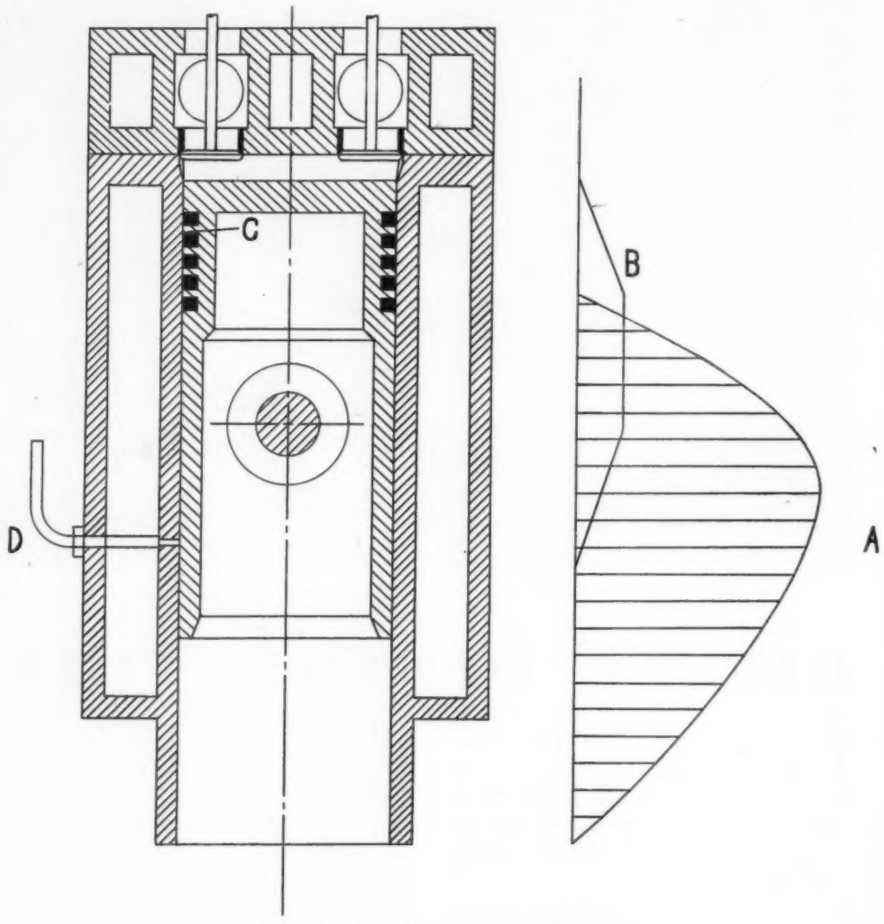


Fig. 1. Lubrication analysis, Diesel engine.

pelled at the crank throw lacks penetrating power; hence it will not reach far upward into the cylinder, the distance being too great to be traversed by a stream of oil-mist, and the very largeness of the cylinder bore makes matters worse. So what may be sound practice for small high speed engines is utterly fatuous for large slow speed engines. To allow the connecting rods to dip into an oil well located within the engine's crankcase is, on the whole, a bad practice. And to fit scoops onto the connecting rods so as to throw large quantities of oil against the lower part of the cylinder gives rise to all sorts of inequities; such an arrangement merely floods one side of the cylinder to excess, leaving the other side totally underlubricated. Fig. 2 will illustrate this.

Maximum lubrication is needed for the shaded areas A and A1, which must bear the brunt of the side-pressure created by the wrist pin, line B – B. The wrist pin not exerting any pressure against the unshaded areas, it is manifest that the piston may readily "float" against the cylinder wall at these points; hence the very minimum of an oil film suffices here. If we now assume that the crankshaft revolves in clockwise rotation, then dipping connecting rods or oil scoops will flood the A1 area of the piston and cylinder with a needless amount of oil, and will starve the A area (which incidentally is subjected to the very maximum of side-pressure under clockwise rotation), and where thus profuse lubrication is required indeed. For anti-clockwise rotation, the same factors apply, but in reverse order. Many an engine is supplied with hollow wrist pins through which lubricating oil is to be conducted towards the cylinder wall. But that means that oil is supplied to the non-shaded areas (Fig. 2), where not much lubrication is needed, and since oil is fundamentally lethargic – gravity has a tendency to induce the oil to trickle back into the crankcase – it is clear that it will not follow a circuitous route unless forced to do so. This, then, is a design in which a mere wish is the father to the thought. Dipping or scooped connecting rods agitate the oil needlessly and thereby give rise to rapid emulsification of the oil, as is well known.

The necessity for adequate top lubrication for pistons and cylinder walls is apparent from Fig. 3, which shows the variation in temperature as existing within an engine.

As will be noted, at T.D.C. the piston and cylinder wall is subjected to a heat of 1,400° F. (in some engines it may be much higher under certain conditions) whereas at B.D.C. these parts need to bear a heat of but app. 675° F.

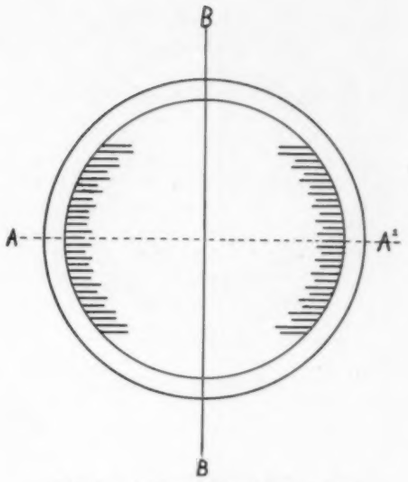


Fig. 2. Areas needing lubrication.

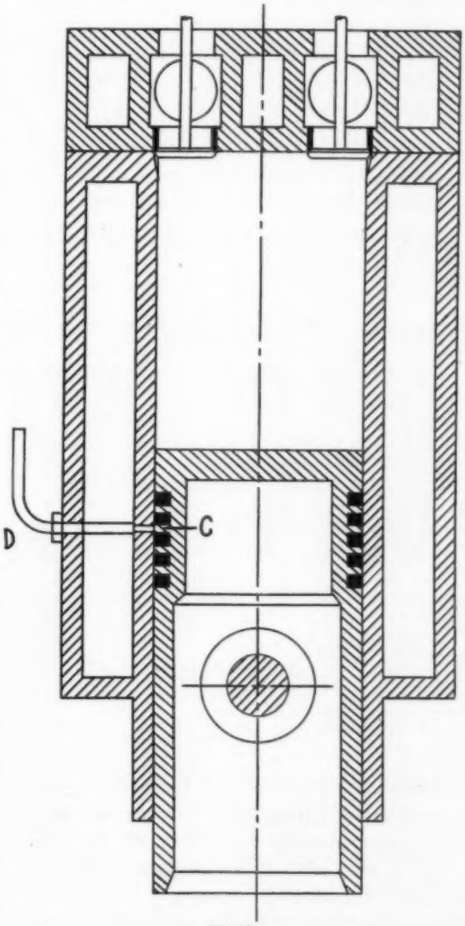
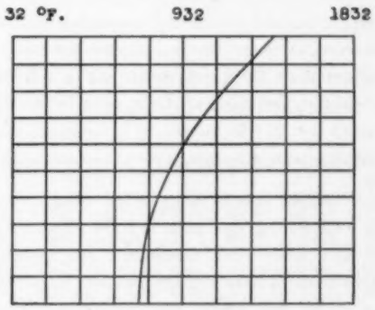


Fig. 3.
Temperature differences between T.D.C. and B.D.C.

Obviously, the greater the heat pistons and cylinders are exposed to, the greater the need for sufficient lubrication. And as we have seen from Fig. 2, the need for lubrication is not uniform for the entire circumference of the piston (maximum lubrication is needed only for the shaded portions) nor is the demand for lubrication equal for the total length of the piston (the need being greatest when the piston is on its downward movement and has reached a point equivalent to one-quarter of its stroke).

The need for "top" lubrication of the piston is evident; oil simply must be carried upwards between the piston rings; and to what extent this must be done is shown in curve "B" of Fig. 1. The practical solution of this problem is not as simple as it may seem, aside from the fact that excessive oil-consumption must be avoided at all costs. A European manufacturer of Diesel engines claims to have solved the top-lubrication issue with an arrangement of oil ducts, as illustrated in Fig. 4.

This manufacturer furnishes his engines with oil ducts which penetrate the water jacket of the engine and lead directly to the inner side of the cylinder (D at Fig. 3). From four to eight ducts are used depending upon the cyl-



inder bore, speed of the engine, etc., the ducts being spaced equi-distant around the cylinder wall. The oil reaches the piston between the second and third ring (C at Fig. 3), and as the piston moves upwards, oil emanating from the ducts will nestle between the subsequent rings and onto the piston skirt. This choice seems a good solution, for if oil were forced to enter between the first and second ring, it would increase the oil consumption immensely, albeit it would reduce ring wear in so far as the first or upper ring is concerned (C at Fig. 1). That the arrangement of C as per Fig. 3 causes greater wear for the first ring (adequate lubrication being lacking at the hottest ring) cannot be denied, but then, technicians always have to choose between evils, and the choice invariably falls upon whatever is considered the lesser evil in any given case.

But the positioning of the ducts, i.e., in an equi-distant manner, is an unfortunate choice. As we see from Fig. 2, the very maximum of

oil is needed at the shaded portions (hardly any at the sides facing the wrist pin); and to have the oil ducts lubricate at the points where the shaded portions end is an unpardonable *faux pas*. One need not be divinely inspired to realize that ducts placed and spaced as per Fig. 5 would be a sounder arrangement.

Oil ducts placed as per Fig. 5 would force the oil to areas where the need for lubrication is greatest, and with such a placement, even the very largest engines would not need more than but six ducts, whereas with an arrangement of equal spacing, none but eight ducts could possibly deliver adequate lubrication irrespective of cylinder size.

Of course, ducts not only require that the piston covers them constantly, but it is also necessary that the piston constantly bears against a solid cylinder wall. This then means that this scheme is not suitable for 2-cycle engines where the piston must traverse the intake and exhaust ports. And even in uniflow 2-cycle engines, where the piston passes over the intake port only, the loss of oil would be great indeed; in fact, duct delivery of oil is for 4-cycle engines only. The need for efficient top lubrication is, however, as great (if not greater) for 2-cycle engines than for 4-cycle ones, and a suitable lubrication arrangement simply must be worked out if the 2-cycle engine is to compete successfully with the high speed 4-cycle engine.

It is claimed that 2-cycle engines usually operate with hot pistons, since in these engines the piston is subjected to combustion heat twice as often as in 4-cycle engines. While this is so, yet in all too many cases the alleged overheating of the piston is not due to the fact that the engine happens to operate upon the 2-cycle principle but rather that adequate piston lubrication has not been provided for. To blame all piston heating upon the frequency of the combustion intervals merely indicates that one fails to distinguish cause from effect. While 2-cycle engines are perhaps a little more troublesome to the technician than 4-cycle ones, in so far as piston cooling and efficient piston lubrication are concerned, the fact remains that we today possess 2-cycle engines in which both of the above problems have been successfully solved.

Since it is not possible to provide for top lubrication of the piston by any (direct) external means, it is evident that the lubricating oil must be supplied while the piston is at or near T.D.C.; that the piston on its downward stroke must "glide over" and not remove the oil film thus deposited upon the cylinder wall, and that with the subsequent upward stroke of the piston, a generous part of the said oil becomes

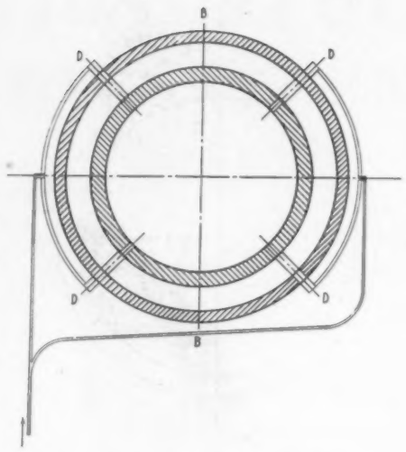


Fig. 4. Engine cylinder with oil ducts.

imbedded between adjacent piston rings to be carried upwards so that top lubrication can be realized. This, then, is the fundamental demand, and ways and means to carry out this scheme of procedure must be devised.

A great deal of grief is experienced from oil thinning out during normal operation of the engine. This will hamper the oil's ability to lubricate, and in extreme cases circumvent it

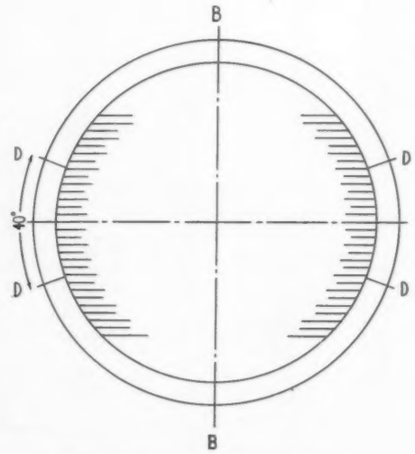


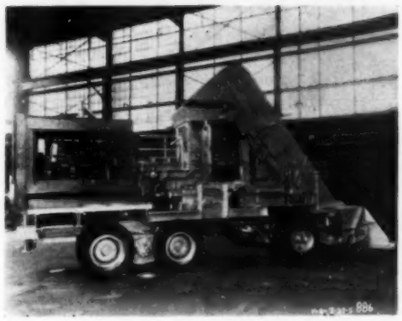
Fig. 5. Proper oil-duct placement.

entirely. It is customary to blame the oil, the stereotyped explanation is that the oil lacks viscosity. Actually, the best of oils lack viscosity when such oils are circulated within an engine at excessive temperatures. Oil entering upon its cycle of lubrication should have a temperature of not much more than 100° F. and the oil draining back into the crankcase after completing its cycle of duty should be cooled so that it may not again circulate until its temperature has been reduced to 100° F. or thereabouts. Also, a sufficient quantity of oil should be provided for, so that the oil does not circulate oftener than ten times per hour, for if oil is driven on its circuitous journey 15 times per hour or even oftener, then even the very best of oils have a tendency to become fatigued and their lubricating ability diminishes accordingly until it borders on the vanishing point in aggravated cases.

Citing a case in point may be the best illustration. A certain make of Diesel engine widely used in marine service, gave more or less constant trouble from overheated pistons, scored cylinders, emulsified oil, etc. These engines were cooled with sea water; and since the cooling water inlet was located at the crankcase, it was thought that leaky joints permitted sea water to drip into the crankcase and thus pollute the oil. While the joints appeared tight, it was held that leakaage might develop when the engines were running, due to vibration. A chemical analysis of the engine's crankcase oil failed to show even a trace of sodium chloride, hence the cooling water (sea water) was not the cause. It was then held that the water content of the oil was due to "cold sweat," e.g., the hot oil and oil fumes coming in contact with the channel feeding cold sea water to the engine's water jackets, had given rise to the formation of water. The engines were promptly altered so that the cooling water would be supplied directly at the water jackets, far removed from the crankcase proper. Yet, the trouble persisted unabated.

Cursory calculations indicated that the lubricating oil was driven on its journey no less than 28 times per hour, a rather high figure. Attempting savings in overall engine height, the lower crankcase was as shallow as it could be made, and the very minimum amount of lubricating oil was carried. The engines had been provided with very efficient oil-coolers, and the overabundance of cold sea water circulating within the oil-cooler reduced the temperature of the oil over 80° F. in mid-summer and better than 110° F. in the winter. And this result was obtained in practically no time at all; the oil was "chilled" rather than cooled.

Remedy: An auxiliary oil tank holding twice the amount of oil the engine had carried was provided for, increasing the quantity of oil to be circulated threefold. This reduced the cycles of oil travel from 28 per hour to but 9 or thereabouts, giving the oil time to recuperate. The size of the oil-cooler was materially reduced and while some 70° F. were still dissipated by the cooler, it was now done by a gentle, slow process; the oil was cooled rather than chilled. RESULT: The water content of the lubricating oil was found to be negligible even after long and forced runs of the engine.



BUDA POWERS ASPHALT MIXER

A DIESEL engine on an asphalt mixer is an innovation, even though the Diesel engine has a wider variety of uses today than ever before. Recently the Iowa Manufacturing Company of Cedar Rapids, Iowa, delivered a Traveling Road Mix Plant on which a Model 6-LD-909 Buda Diesel Engine furnishes the power.

This plant has 1,000 gallon supply tank, equipped with kerosene pressure burners for maintaining even temperatures of the bitumen in the tank during operation. The aggregate batcher is synchronized with the asphaltic material measuring pump, and every operation is so regulated that the materials are mixed in the proper proportions. Proper proportions mean uniformity of mix and hence better roads.

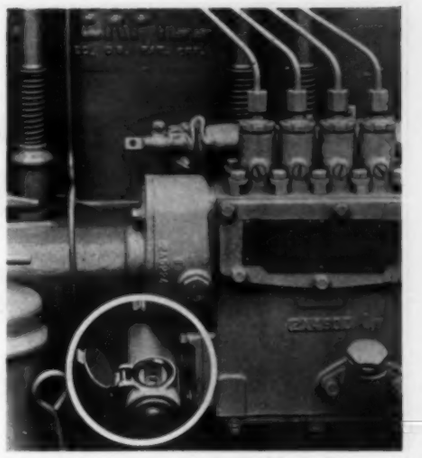
The Buda Diesel used to power this plant is a 6-cylinder model, with 5¼" bore, 7" stroke, and 909 cu. in. displacement. This engine uses the "Controlled Turbulence" combustion system, which has been employed on all Buda Diesels for some time. Among the chief advantages of this combustion system are: lower compression ratios, lower maximum cylinder pressures, lower piston temperatures, higher mean effective pressure, and lower specific weight.

HOUR METER

HENCEFORTH an hour meter will be standard equipment on all three, four and six cylinder Diesel engines produced by the Caterpillar Tractor Co., according to an announcement made recently.

This meter was made available as an attachment about two years ago. The many that have been used during this period, have definitely proved the value of such an instrument and its use will eventually mean as much to the Diesel engine owner and operator as the speedometer does to the automobile owner.

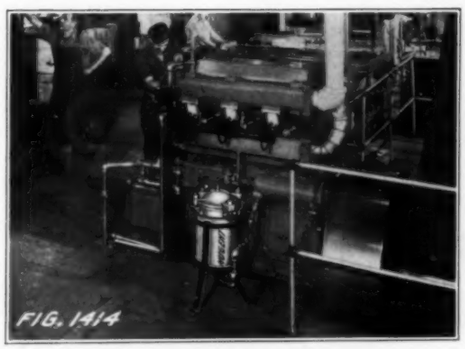
The hour meter is a sturdy, durable unit with a large dial that is easy to read. It is attached to the rear of the fuel injection pump housing and is driven by the end of the shaft, fitting between the heads of the cap screws in the end of the fuel injection pump camshaft. The hour meter registers one number for every hour the engine operates at standard rated speed.



Just as the mileage indicator part of the speedometer has become the standard for measuring the life and maintenance intervals of the automobile, so will the hour meter be generally used as a guide for lubricating and maintaining the "Caterpillar" Diesel engine.

NUGENT OIL FILTER IS SELECTED TO PROTECT

THE 60 H. P. COOPER-BESSEMER DIESEL ENGINE AT THE LANGBEIN CUTLERY CO. BROOKLYN, N. Y.



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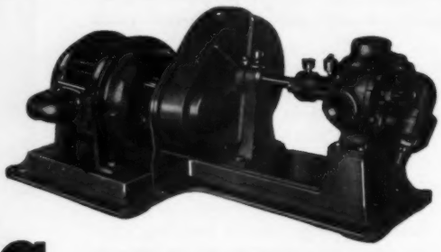

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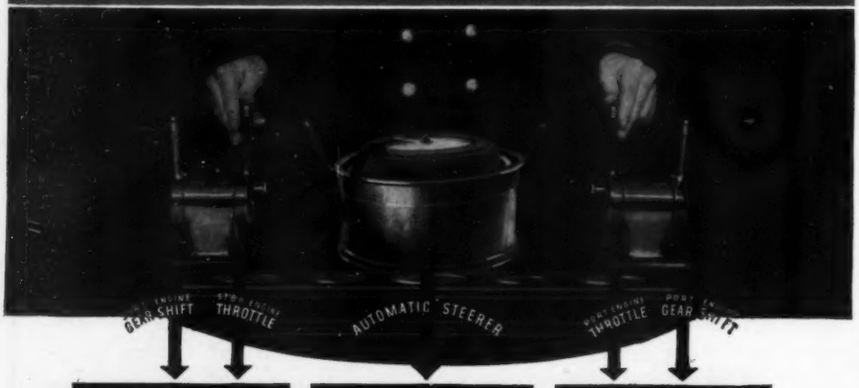
BENDIX *Finger-Tip controls*

DOUBLE THE EASE OF POWER YACHTING!



THROTTLES—Manual Finger Tip Control through Hydraulic Lines and Actuators to Carburetors or Fuel Injectors. (No leakage—no play.)

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YOU can't afford to build obsolete controls into an otherwise modern boat—it doesn't make sense. Ask your favorite naval architect, marine engineer or modern-minded motor sailor.

★ Bendix Control Pedestals ★ Throttle Actuators ★ Push-Button Controls ★ Bendix-Holmes Automatic Steerer ★ Bendix Electro-Vacuum Power Gear Shifter ★ Flexible Metallic Exhaust Tubing

Any or all Bendix Controls may be readily installed on most existing Yachts — either gasoline or Diesel powered

BENDIX PRODUCTS CORPORATION
(Marine Division)
493 Bendix Drive South Bend, Indiana

LOGGING THE WESTERN MOUNTAINS WITH DIESELS

. . . . *Continued from page 25* . . . .

tors have piled them, down a mountain side too steep to use a tractor. The logs just coast down the hillside anyway.

As North Pacific logging operations reach higher levels water supply becomes as costly and scarce as fuel oil. The Diesel again proves its economy by using only a gallon or so per day of makeup cooling water. You can run 20,000 feet of logs per hour with a Caterpillar Diesel and cruiser on 5½ to 6½ gallons of 7-cent fuel. And IT COST $1 PER HOUR FOR TWO MEN TO CUT FIREWOOD FOR THE STEAM DONKEY!

So efficiently organized is the supply end of the Western logging industry, that it doesn't pay to put large investments in repair shops for equipment. The old days required large machine shops to make special castings and parts for the steam rigging. Now you telephone to the city and 75 per cent of the replacement parts can be had on IMMEDIATE DELIVERY basis, and 25 per cent on 24-hour basis. When something wears out or breaks, it's a matter of hours and half the cost to put a brand new part in place on the Diesels. But not so with a steam rig.

These Diesels run 3,000-4,000 hours without overhauling. Lube oil, to the tune of 7½ gallons at a filling for the RD 8's, is put in fresh every 60 hours' running time, and oil filters changed also. There is no replacing oil in dribbles. Sixty hours' use and then a fresh batch of new oil, costing about 60-65 cents per gallon delivered to the woods.

No trained experts are needed to maintain the "Cats"—the young lads that drive their Model A's can quickly learn to operate a "Cat," and after a short time do many repair and replacement jobs without taking the machine back to the shop in camp.

Meanwhile all-Diesel yarders are replacing the old steam equipment rapidly. Up and down the Coast the woods are being Dieselized. One large company, with long log haul on rails, even uses Diesel-Electric locomotives for line work. And Diesel trucks for highway hauling are coming along nicely. Over 50 Coast companies use Diesel yarders, while over 150 operations use Diesel tractors.

The West Fork operation looks as though it will be the first all-Diesel setup in the West, and the first completely selective logging operation in the country, a tribute to Mr. Murray's far-sightedness. And this fine operation would make Theodore Roosevelt turn over in his grave and smile broadly, with satisfaction. The forests are actually being saved, yet their usefulness increased.

S. A. E. NEWS

TWENTY-ONE S.A.E. members from at home and abroad are expected to contribute, with papers dealing directly with Diesel engine lubrication or with lubrication problems that the Diesel shares with other internal-combustion engines, to the Discussion on Lubrication and Lubricants, sponsored by the Institution of Mechanical Engineers to be held in London, Oct. 13-15.

* * *

"Cylinder Lubrication for Small-Bore Diesel Engines," is the title of the paper for the London Conference, being prepared by C. G. A. Rosen, in charge of Diesel development, Caterpillar Tractor Co. It will be concerned with "the struggle of the small-bore Diesel engine in maintaining a supporting oil film in combat with depositions of carbon and binder-forming tendencies."

Another of Mr. Rosen's contributions to Diesel engineering is published in the September, 1937, issue of the *S.A.E. Journal*. It is called: "The American Picture—Diesel Fuel Research," and reviews fuel research at the San Leandro laboratory of the Caterpillar Tractor Co., made on a precombustion-chamber Diesel burning California-base fuels.

* * *

In addition to Mr. Rosen, seven other S.A.E. members have been invited by the S.A.E. to discuss such vital and widely debated phases of engine lubrication and lubricants as oiliness, friction and wear, selection, and cylinder wear, through C. Herbert Baxley, S.A.E. vice-president, representing the Fuels and Lubricants Engineering Activity, at the request of the I.M.E. These men are D. P. Barnard, A. L. Beall, A. W. Burwell, H. A. Everett, F. L. Miller, G. L. Neely, and Alex Taub. Foreign S.A.E. members also will play an important role in the London lubrication forum; they represent 9 of the 13 other S.A.E. men listed by the I.M.E. as agreeing to present papers, as follows: D. C. P. Neave, S. A. McKee, H. M. Richardson, C. H. Barton, E. L. Bass, G. D. Boerlage, O. T. Jones, E. C. Ottaway, C. Fayette Taylor, R. Coulson, H. E. Merritt, J. C. Geniesse, and Gordon McIntyre.

* * *

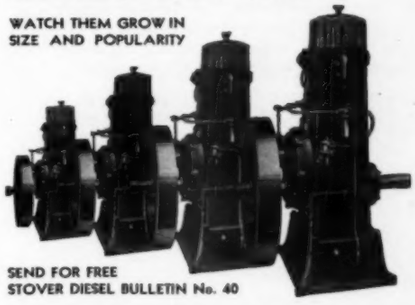
Returned from overseas is S.A.E. research manager C. B. Veal, who visited England, France, Germany, Belgium and Holland attending meetings, and informal conferences having to do with automotive engineering interests in general and fuels and lubricants developments in particular. With S.A.E. Vice-President Herbert C. Baxley he visited the Delft, Holland, laboratory of N. V. de Bataafsche Petroleum Maatschappij, where, among other things, they saw in operation several high-speed Diesel engines of different types and sizes for investigating Diesel fuel behavior.

STOVER *Diesel* ENGINES

Cut Power Costs 75%

In STOVER true Diesel Engines, ½ gallon of non-explosive Diesel oil generates as much power as 1 gallon of gasoline in any other type engine—at ⅓ the cost. 45 years of engine-building experience backs STOVER Diesel efficiency, dependability, economy and long life. They can be brought to full load, from a cold start, almost instantly. STOVERS are true Diesels, needing no carburetor, electrical ignition nor frequent attention from specially trained operators.

WATCH THEM GROW IN SIZE AND POPULARITY



SEND FOR FREE STOVER DIESEL BULLETIN No. 40

If you are paying peak demand charges for power it will pay you to find out just how much a STOVER Diesel will save you. Write Dept. DE-64.

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Diesel Fuel *and* Lubricating Oil Purifier *for* Land *and* Marine
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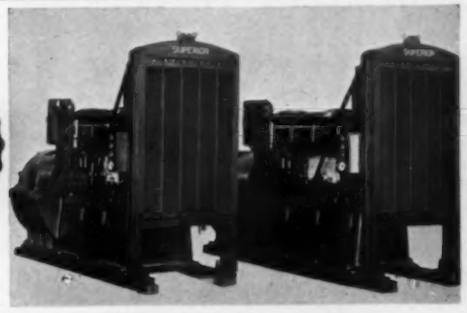
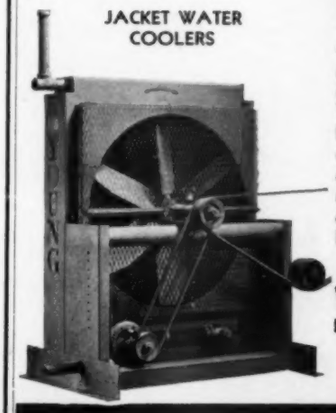
OIL COOLERS



JACKET WATER COOLERS



YOUNG COOLING SURFACE

● Development of cooling equipment for Jacket Water and Oil has kept pace with the great increase in the uses of Diesel Engines, for all types of power applications. The Young Research Laboratories have been working for several years compiling data and making tests on new cooling units, with the result, that a Young Unit is available for any specific cooling job which you may have to perform. Each unit has been carefully developed and is based on exhaustive tests as well as a wealth of field experience.

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Portland, Oregon

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CUNO ENGINEERING CORPORATION

CHARLES H. CUNO, president and treasurer of the Cuno Engineering Corporation of Meriden, Connecticut, announced recently that the company had accepted delivery of a new Stinson Reliant aeroplane, to be used in experimental work for filters produced in Meriden, and also for use in contacting customers in various sections of the country.

The plane, fully equipped with all necessary instruments for blind flying and powered by a 320 hp. Wright Whirlwind motor, was flown to Meriden from Detroit, Mich., recently by Lt. Ernest L. Markham, manager of the Meriden airport, who was accompanied by Mr. Cuno. The trip consumed four hours and a half, with a stop being made at Syracuse, N. Y.

Mr. Cuno states that the plane will be housed at the Meriden airport where it will be in charge of Lt. Markham. It will be used chiefly for experimental testing of filters and other devices manufactured by the company.

The plane is beige and brown in color, and has the Cuno Engineering Corp. trademark on either side. Over the trademark in large letters are the words "oil and fuel filters," and below the trademark, the words "air, land and sea."

Mr. Cuno expects that the plane will be used to excellent advantage in contacting customers.

FAST NAVAL TANKERS

TO increase facilities for oil transport, the British Admiralty is taking over six motor tankers that were ordered by the British Tanker Co. They are vessels of about 12,000 tons d.w.c., and have a speed of approximately 12 knots. In Japan some tankers have recently been constructed with a speed of from 17 to 18 knots. They are nominally for private ownership, but have no doubt been built with naval possibilities in view. In Italy two large tankers with a speed of 16 or 17 knots have just been ordered, and it is understood that in America fast tankers are being laid down. In view of the importance of speed in oil transport for replenishing ships in the event of war, it is urged in *The British Motor Ship* that the Admiralty should build at least a limited number of motor tankers with speeds as high as those of ships built in other countries.

Such a course of action might well be considered by our own Navy. The Editor.

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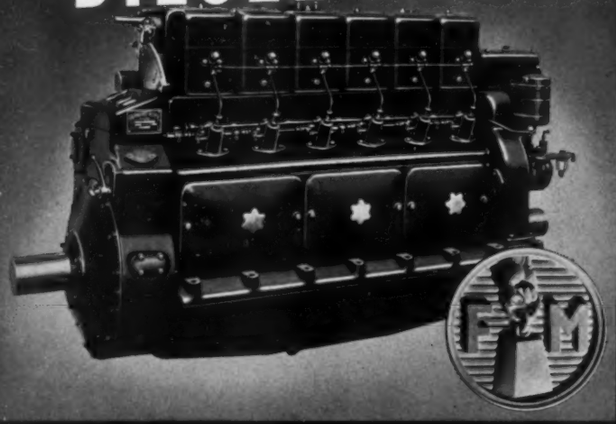
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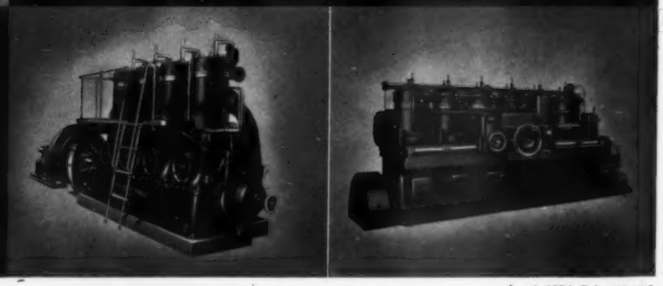
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The complete Diesel drilling rig with Hercules Diesel in place just before shipment to Palestine.

HERCULES DIESELS CUT DRILLING COSTS IN PALESTINE

CANTON, Ohio — Information received by officials of Hercules Motors Corporation indicates that a great amount of new agricultural development work is taking place in the Near East. This has created an increasing demand for well drilling equipment to be used in providing water and irrigation for many projects.

In order to procure some of the business so long held by the Czechoslovakian and Italian firms, writes Mr. E. I. Mohl, Secretary of the Near East Water Development Company of Jerusalem, Palestine, his company recently purchased a complete water well drilling unit manufactured by Roscoe Moss Company of Los Angeles, and powered by a Hercules DRXB Diesel engine. This rig, which is of the Cable Tool type, is capable of producing a superior well in considerably less time than the old style rotary or jet methods prevalent in Palestine.

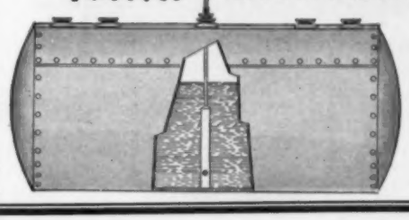
7,000-HP. UNIT SOLD

GENERAL MACHINERY CORP., manufacturers of the Hamilton-M.A.N. Diesels, announced that they have sold a 5,000-kw. Diesel unit to the Salt River Valley Water Users' Association, Phoenix, Arizona. This 7,000-hp. engine will be an exact duplicate of the five units installed at Vernon, California, with the exception that the generator on this new job will be a General Electric 25-cycle unit. The new engine is to be used for standby and peak load service for the Association's hydro-electric system and completion of the installation is expected by April, 1938.

PETROMETER DISTANT READING

For the BEST DIESEL **INSTALLATIONS**

TANK GAUGES



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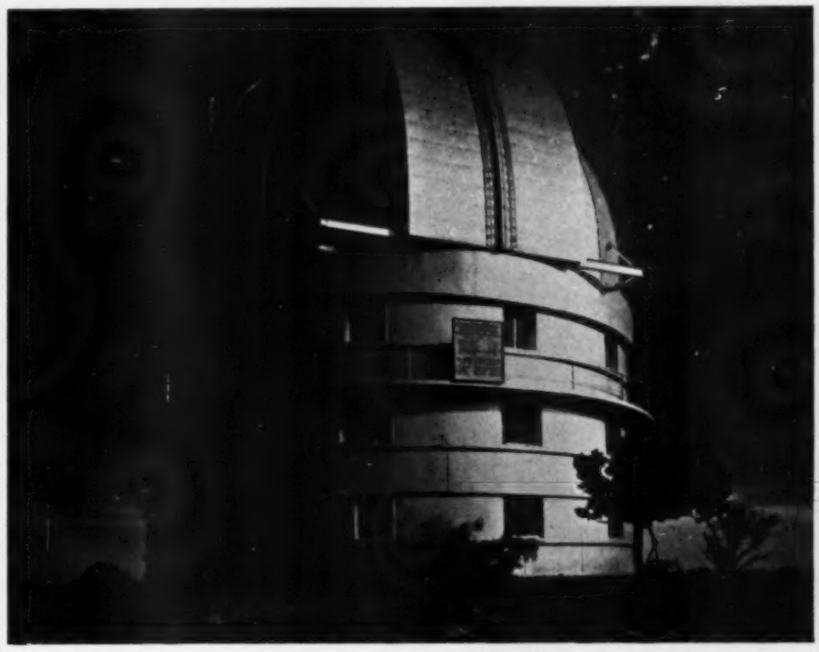


New worlds to conquer!

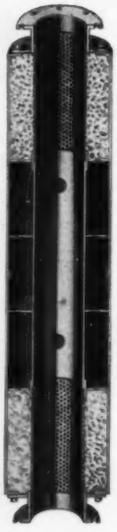
- Just as the modern astronomical equipment of today widens the scientists field, so do Maxim Silencers increase the scope of the Diesel Engine. With Maxim D04F Silencers, installations, undreamed of a few years ago, can now be successfully made.
- The new McDonald Observatory of the University of Texas is supplied with electrical power by Winton Diesel Generator Sets. Maxim D04F Silencers installed on the engines reduce the exhaust noise to a whisper.

THE MAXIM SILENCER COMPANY
HARTFORD, CONN. 50 CHURCH STREET, NEW YORK CITY

the New Burgess I-F Series Air Cleaner

Harmful dust and grit are effectively removed from Diesel engine intake air by the new Burgess I-F Series Air Cleaner. The filter in these units consists of specially wound copper gimp with a viscous coating which effectively retains dust and grit.

The new I-F Series Air Cleaner is intended for heavy duty service either by itself or—if silencing is required—in conjunction with the Burgess CA Intake Silencer. It is very compact and, because of its large surface area, offers very little resistance to air flow even when heavily loaded with dirt.



Burgess CA Series Intake Silencer for Diesel engines and compressors.

The outer casing of perforated metal effectively retains the larger particles and protects the filter.

The I-F Series Air Cleaner requires a minimum of service. When cleaning is necessary, the filter can be easily removed, washed in kerosene, reoiled, and replaced.

Burgess also manufactures a complete line of straight-thru intake silencers and exhaust mufflers. Write for bulletins.

Burgess Battery Co., Acoustic Div.
111 W. Monroe St., Dept. DPR
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BURGESS ACOUSTIC

Licensed under C. F. Burgess Laboratories, Inc., Patents

HYDRAULIC COUPLING APPLICATION

THE first excavator with hydraulic coupling equipment to be put in service in the United States has proved a big money and time saver for the Grand River Gravel Company, which is stripping gravel near Ionia, Mich., according to W. R. Doran, manager. The coupling is applied in place of the conventional friction clutch to a Marion 1¼ cubic yard excavator and has been in service since last spring.

It has prevented breakage of cables and machinery from sudden strains and has made operation smoother, Mr. Doran said. Unlike the friction clutch, the coupling "slips" when the safe load maximum is reached without stalling the engine or breaking cables or machinery.

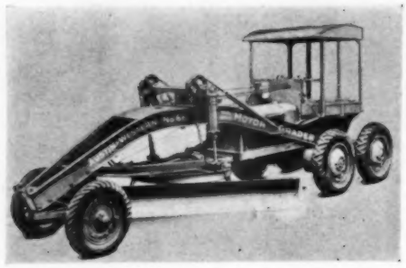
Mr. Doran estimates that the coupling saves a minimum of 10 per cent in excavating costs and that savings up to 20 per cent are possible for excavator owners under more severe operating conditions.

Among the coupling's many advantages is its ability to smooth out tortional variations. A total of from one to two million horsepower of hydraulic coupling equipped machinery is in use today, the greater part of it Diesel powered.

BUDA DIESEL GRADER

THE Austin-Western Road Machinery Company of Aurora, Illinois, has recently announced their new Model "66" Motor Grader with a Diesel engine as standard equipment. The Diesel is the popular Buda Model 6-LD-275, built by The Buda Company of Harvey, Illinois. The engine is the smallest six-cylinder model of the Buda line, has a bore of 3½", stroke of 4¾", and 275 cu. in. displacement.

The grader is equipped with hydraulic controls, is available in either Single or Dual Drive, has a wide range of speeds, correct distribution of weight, and 60 inch blade circle. The exclusive Austin Anti-Chatter Device eliminates all blade chatter and permits a smooth, even cut. The "66" is especially recommended for all around highway work.



The above advantages of the Model 6-LD-275 Buda Diesel, coupled with its flexibility and compact, sturdy construction have made it most desirable as a power plant for all types of material handling and construction equipment. Many other manufacturers of all types of equipment have used this model extensively. Scores of "275's" have been shipped to foreign countries.

Without doubt, during the next few years we shall see more and more manufacturers standardizing on Diesel engines as power for their various types of equipment.

Now available with **DIESEL POWER**

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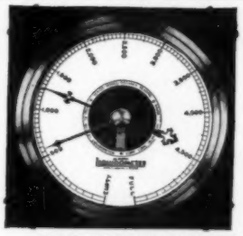
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DIESEL PROGRESS

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Whatever the size of engine that may be required or if there is a preference of type or design, the extensive line of Nordberg Diesels permits the selection of the proper engine for each individual need. They can be had in sizes from 150 horsepower upward.
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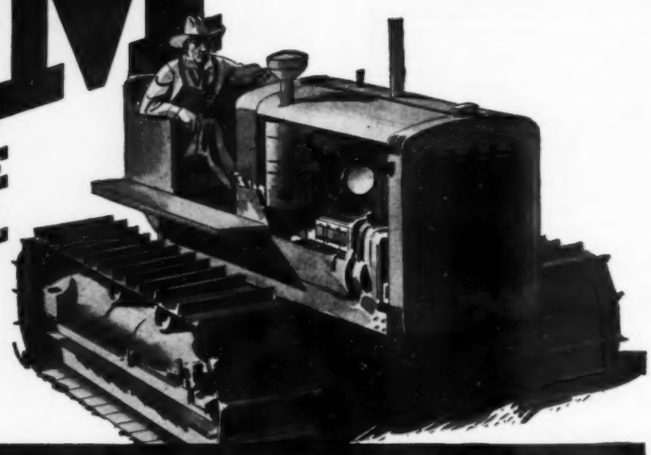
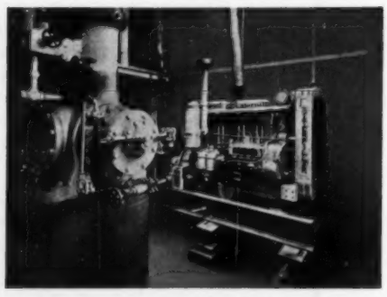


WORLDWIDE ACCEPTANCE

An Alabama "Caterpillar" distributor writes: "Have watched 'RPM' Diesel Engine Lubricating Oil perform under every type of service, since in our territory 'Caterpillar' Diesels are employed in every conceivable type of work. 'RPM' Diesel Engine Lubricating Oil performance is outstanding."



An Illinois owner writes: "Engine is operated 24 hours a day on a compressor in a refrigerator plant. No indication of blow-by. Uses no oil between changes. Has run 2200 hours. Operating on 'RPM' Diesel Engine Lubricating Oil."

Full power under sustained loads and heat. Freedom from carbon and sludge. Minimum blow-by.

TO ALL "CATERPILLAR" DIESEL OWNERS:—Caterpillar Tractor Co. recommends "RPM" Diesel Engine Lubricating Oil. "Caterpillar" distributors service their engines with it. "Caterpillar" owners acclaim it. They'll tell you that after thousands of hours of blistering, heavy-load operation, *with "RPM" Diesel Engine Lubricating Oil,* piston rings move freely at the slightest touch of a finger —cylinder walls remain smooth, without a trace of scoring.

With its tough film of high oiliness, *specially compounded* "RPM" Diesel Engine Lubricating Oil keeps your Diesel engine lubricated. Keeps rings clean—free from carbon. Minimizes blow-by and power losses. Prevents sludge. Keeps oil channels open. Try "RPM" Diesel Engine Lubricating Oil. Learn why this *patented* product is the most widely used Diesel engine lubricating oil in the world.

STANDARD OIL COMPANY OF CALIFORNIA

"RPM" DIESEL ENGINE LUBRICATING OIL IS DISTRIBUTED IN THE UNITED STATES BY:

The California Company (Distributors in Montana)
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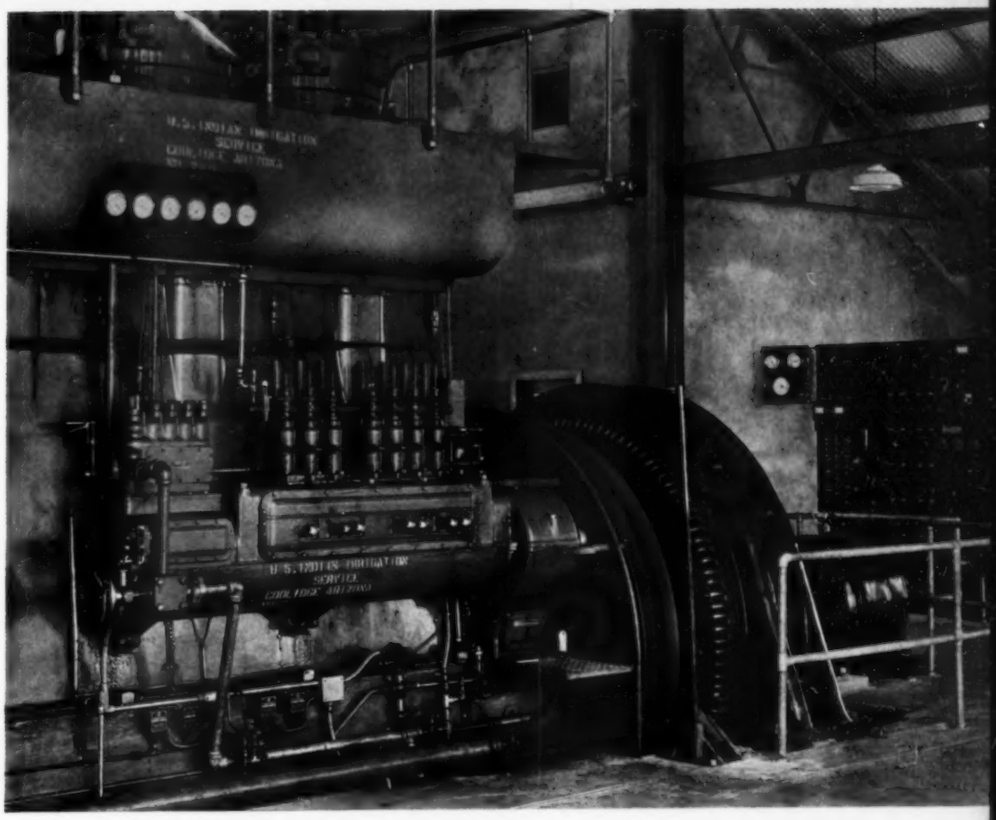
Lo, the fortunate Indian-

ELLIOTT GENERATORS make things easier on this Indian Reservation



One of two Diesel-Elliott units in the Indian Reservation near Coolidge, Arizona. The generators are 1165 kva., 257 r.p.m., with direct-connected exciters.

THE BLESSINGS OF CIVILIZATION have brought little but demoralization and ruin to the first Americans. But the Pima and Maricopa Indians on their reservation in the Arizona desert, do not feel that way about the Diesel-driven Elliott Generators which furnish power to help irrigate their baking fields. Agriculturists for countless generations, with water their great need, these Indians no longer depend upon native rain-makers, witch-doctors and tribal dances. They find Diesel-driven, Elliott-generated power much more certain. Dependability is only one vital attribute of Elliott Generators. Another is economy — obtained through the close cooperation of generator with Diesel, which is possible only where the generator is designed specifically for its job — as all Elliott Generators are.

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Investigate Elliott Generators for use with your Diesels. Write us.

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1905 — Thirty-two Years — 1937

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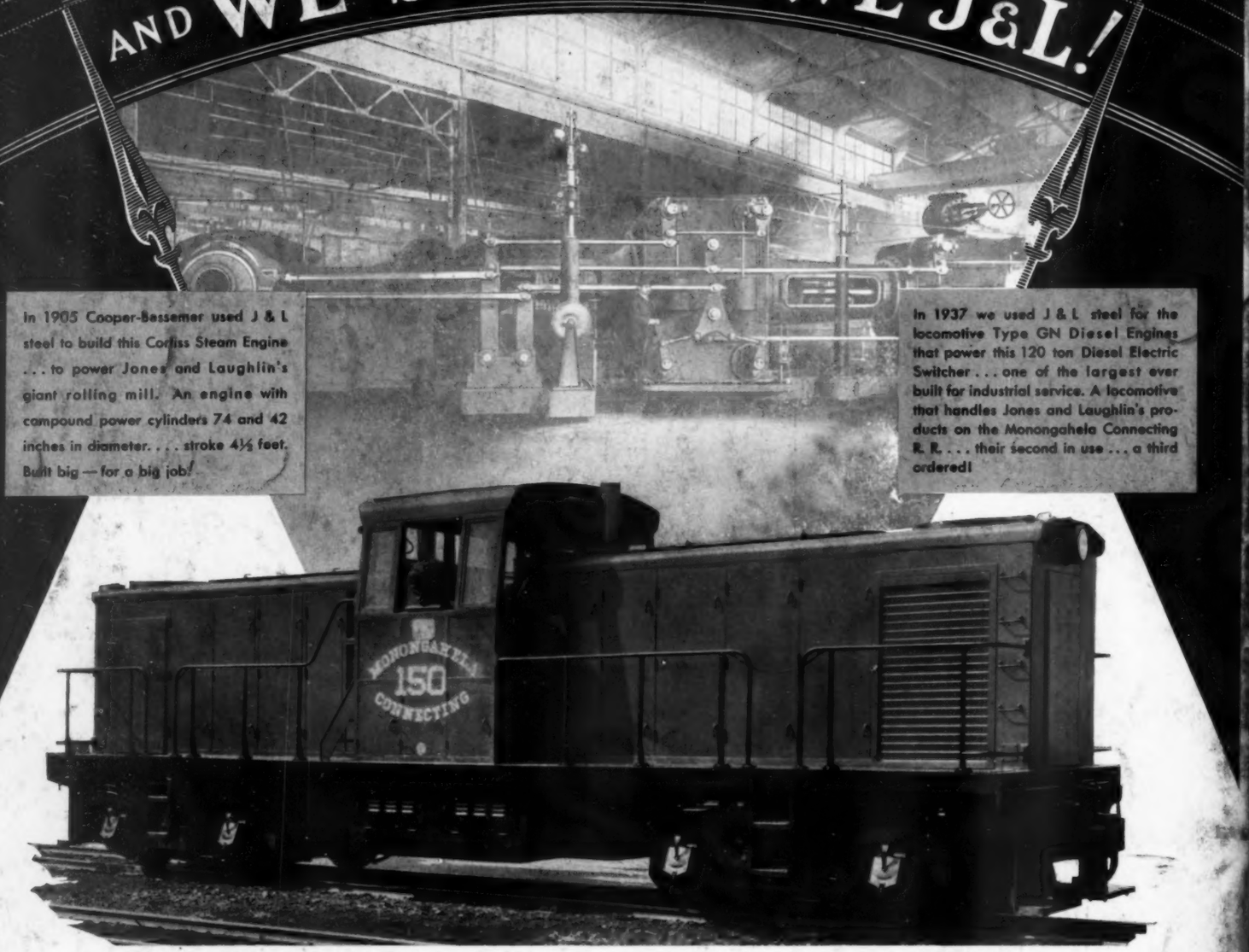

In 1905 Cooper-Bessemer used J & L steel to build this Corliss Steam Engine . . . to power Jones and Laughlin's giant rolling mill. An engine with compound power cylinders 74 and 42 inches in diameter. . . . stroke 4½ feet. Built big — for a big job!

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